



EDITORIAL
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11th Annual Printer **Blockbuster**

**NETWORK
EDITION**
MAGAZINE

From Workgroup
To Enterprise: We
Test 28 Networked
Printing Solutions

Mixed Shop?
8 Print Servers
That Cross
Platform Lines

PC LABS TESTS 109

Printers

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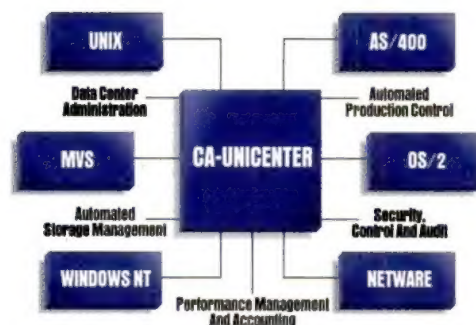


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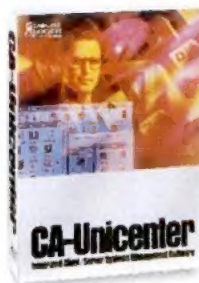


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Inside

It's *PC Magazine's* annual Rite of Printers, and this marks our eleventh go-around. Over the years more than 1,100 printers have wound their way through our testing procedures. The technologies and the test methodologies change, but with over a

hundred new printers for each year that we've tested, there's no sign of letup in volume.

In 1984, "Project Printers I" tackled 120 printers; most were dot matrix (the Centronics interface reigned supreme) and the



**Our eleventh annual printer issue:
My, how things change!**

majority cost upwards of \$600. Just as testing for that first printer issue was coming to a close, a new breed of printers, based on the Canon personal copier print engine, was born. The new "gotta have it" printer was called the HP LaserJet, and it cost \$3,500. The promise of blissfully quiet printing and an end to the jaggies made it the status symbol of 1985.

Two years ago we were duly impressed when laser printers broke the \$1,000 barrier, but this

year, the price of a laser printer like the Brother HL-630 is about \$400. Replacing the black-and-white laser on the status-symbol list is a new crop of color lasers that legitimize this long-awaited sector of the market. But if the \$7,000 to \$10,000 price tag of a color laser doesn't fit your budget, you'll relish the ten new color ink jets we review. They use rich, color-fast inks and work with plain paper.

While daisy wheels have been relegated to museum status, dot matrix printers, now available for as little as \$100, are still a \$3-million-a-year business. As executive editor Bill Howard says, "They may be dead, but the heart's still beating." And this year, to round out our printer coverage, we take our most comprehensive look ever at network-capable printers and the world of high-end color printers.

Behind every Project Printer campaign is deft planning and strategy. This year's medal of bravery goes to associate editor Leon Erlanger and project leader Mike Zulich. This is Mike's fourth printer issue, and Leon has just completed his second tour of duty.

The *PC Magazine* printer issue is one of the long-standing traditions that serve as guideposts for where we've been and where we're going.—Robin Raskin

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Flat Square Screen	•	•	•	•
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Real Color Control			•	•
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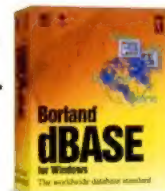
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COVER STORY

Printers

11th Annual Printer Issue

BY BILL HOWARD

Welcome to our eleventh annual printer blockbuster, where we dedicate the majority of the magazine to [reviewing the year's new entries](#). Here we look at 109 machines, divided among five feature sections: personal and workgroup lasers, departmental lasers, ink jet printers, high-end color printers, and dot matrix printers. The big news this year: Color is everywhere, from affordable ink jets to color lasers that are getting better all the time.....110



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Personal/Workgroup Lasers

Affordable and Feature-Rich

BY ALFRED POOR The traditional mainstream laser market is splitting in two: printers for individuals and small offices, typically capable of delivering 4 to 6 pages per minute, and more robust 8- to 12-ppm lasers for workgroups to share on a network. For the first group, the sub-\$400 laser printer has arrived. For the second, the choices have never been more varied. In either group, you'll find more features and better output than ever before123

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Departmental Lasers

Fast and Flexible

BY JAMES KARNEY AND LEON ERLANGER The fastest-growing segment of the laser printer market is departmental lasers—networked workhorses that produce output in excess of 12 pages per minute. Beyond a fast engine and a hefty duty cycle, today you need direct connection to the network, bidirectional communications, remote management, and maximum flexibility197

High-End Color

The Best and the Brightest

BY M. DAVID STONE Ink jet printers and color laser printers may be producing better images with each passing year, but for truly spectacular color output you still need a dedicated color printer. In this [roundup we look at 11](#) high-end color printers, which range in price from roughly \$1,600 to \$17,000225



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Ink Jets

Color Conquers SOHO

BY LORI GRUNIN For small-office and home-office users, the best all-around printer choice may be an ink jet. Ink jets are quiet, relatively quick, and inexpensive—starting at under \$300. And if you want good color images for business presentations or personal use, ink jets are the only affordable option in today's marketplace.....249



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BY BRUCE BROWN Dot matrix printers are quickly losing market share to low-cost ink jets. But for high-volume printing, printing multipart forms, or simply churning out the cheapest output possible, one of these 29 printers should fill the bill285

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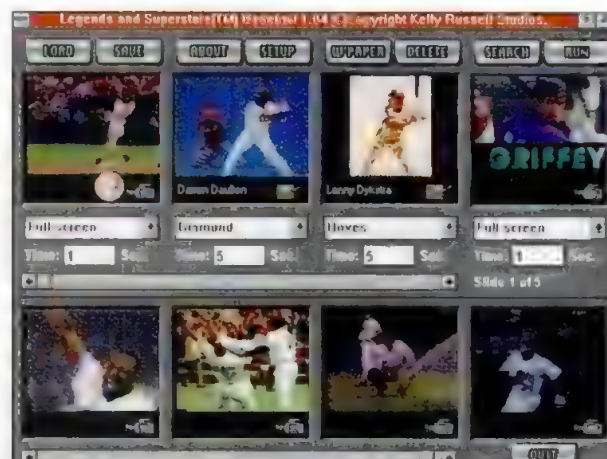
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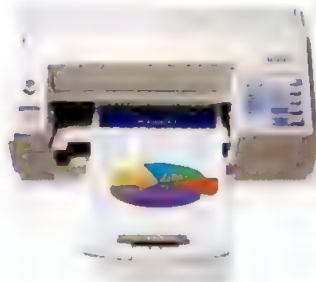
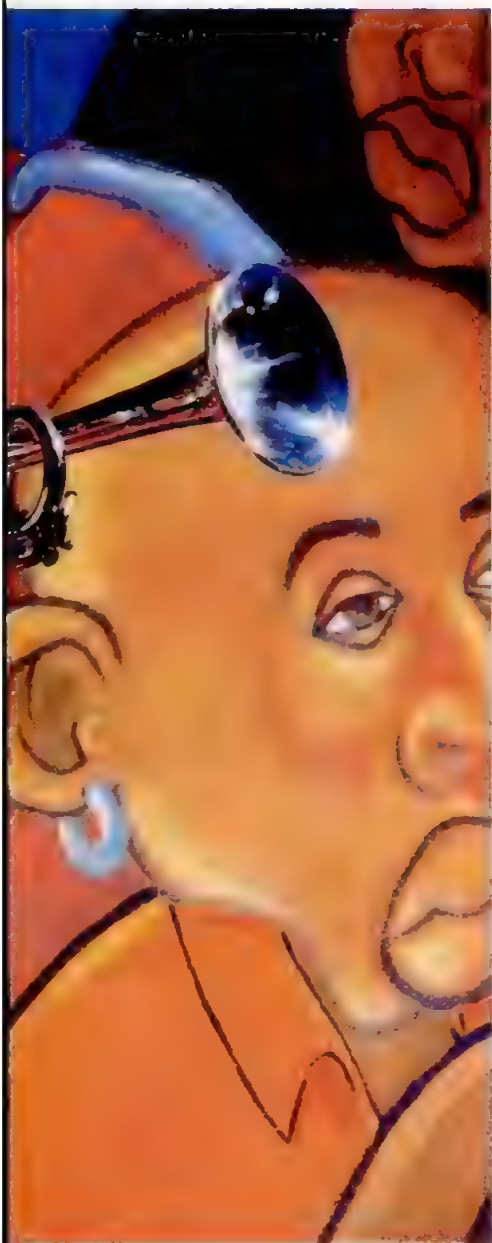
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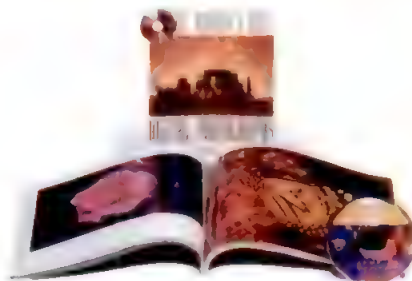
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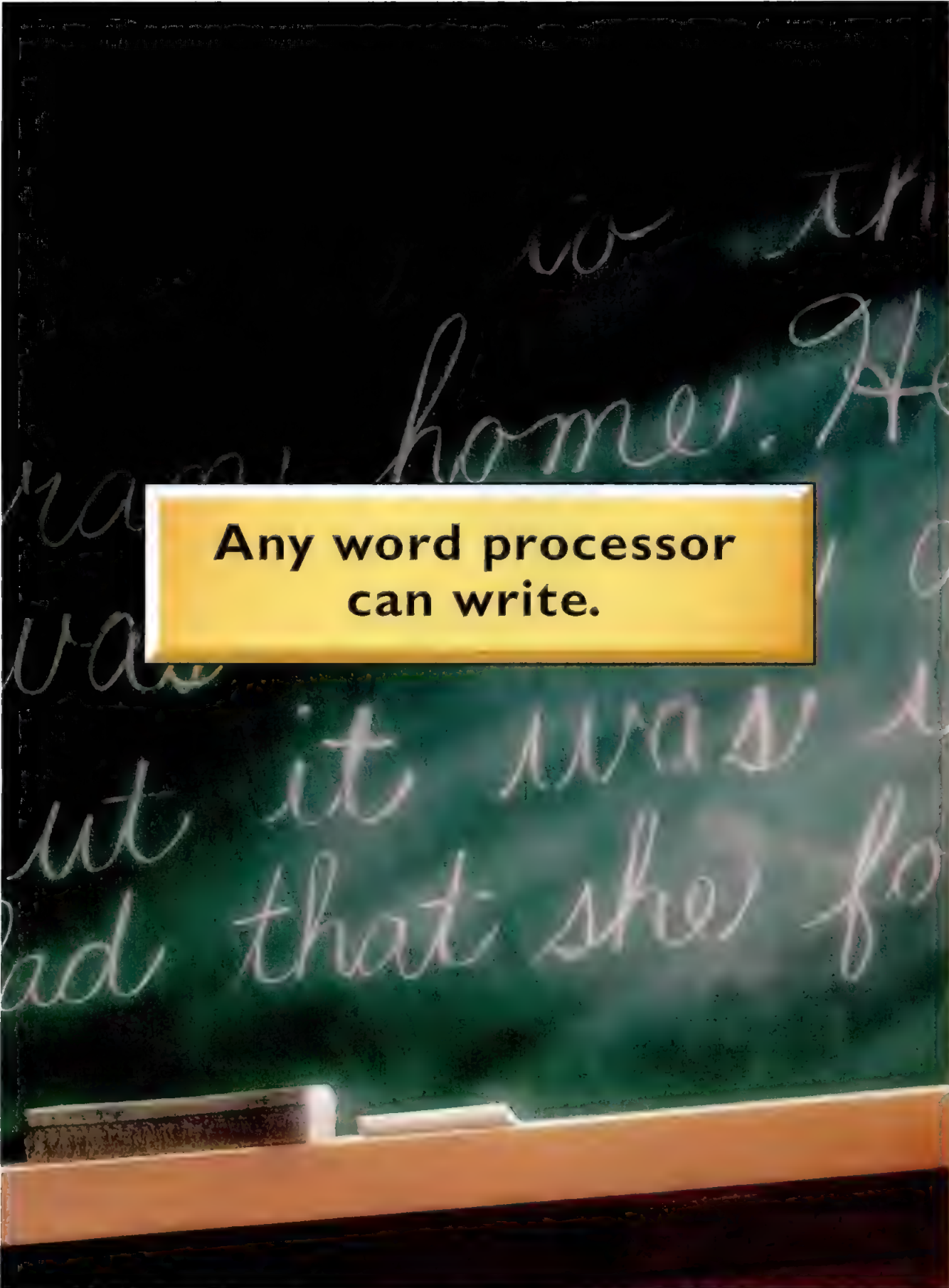
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A green chalkboard with faint, cursive handwriting in white chalk. The visible text includes "to the", "home. He", "it was", and "that she fo". A yellow rectangular box with a black border is centered on the board, containing the text "Any word processor can write." in bold black font. At the bottom of the board, there is a wooden ledge with two pieces of chalk resting on it.

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Letters

A PIECE OF THE ACTION

John C. Dvorak's columns are always entertaining and informative, but sometimes he tends to be elitist, as exemplified in his column "It's Time to Bust Up Microsoft" (July 1994). He claims to believe in free markets while maintaining that Microsoft is monopolizing the industry and should be broken up. But his conclusion does not follow from his premise. If you believe in free markets, then you don't believe in breaking up Microsoft. Consumers are the best judges of what works; if Microsoft loses touch, just watch how fast it will lose market share. Busting up Microsoft would be a tragic mistake.

*Raymond Hewitt
Montville, New Jersey*

How can faithful service to one's customers be considered a monopoly? There are other operating systems and software products available. Should the public choose to use a product that does what is promised over products that are cumbersome and incompatible, then so be it. After all, that's what free enterprise is all about.

*Gregory D. Furnish
via PC MagNet*

Though I tend to agree with Dvorak's views, we should ask ourselves what would have become of the desktop PC market without Microsoft. It would most likely have been so fragmented or misdirected that we would not have seen anything like what we have today.

*Paul Rarey
via the Internet*

Dvorak's column was thoroughly enjoyable. Microsoft's anticompetitive, monopolistic, and generally disdainful attitude has fostered a spirit of arrogance that is truly disappointing. It's time for Microsoft to play fair.

*Chris Mardorf
via PC MagNet*

Microsoft should be rewarded, not penalized, for its hard work, years of dedication, and vision of the future. Considering how



Consumers are the best judges, and that's reflected in market share.

many American companies sell their technology to foreigners to make a fast buck and cut their R&D budget before their expense accounts, Microsoft is a veritable model corporate citizen. How many computer companies have a ten-year vision? The few that do are the successful ones.

*D.J. Scarletta
via PC MagNet*

People don't buy Microsoft's products because they've been brainwashed or because Microsoft is the only game in town. They buy Microsoft's software because it provides a solid solution to their business needs. And to assert that Microsoft's success in the software market stifles creativity is ludicrous and insulting to the hundreds of good non-Microsoft products on the shelves.

*Keith Stillinger
via PC MagNet*

Congratulations to Dvorak and his refreshing column pointing out how much influence Microsoft has; as usual, Dvorak has his finger on the pulse of the industry. Although Microsoft's clout was initially a blessing in the early years of PCs when a lack of standards and compatibility made it difficult to complete even the simplest

tasks, Microsoft has now become an impediment to the creativity and growth of the industry.

*Bryan M. Gaetjens
via the Internet*

RAD VICTIM COMES FORWARD

Robin Raskin's column gauging the worth of development systems (Pipeline, "Is RAD the Next Fad?", September 13, 1994) was one that I enjoyed immensely. I too am a victim of rapid application development (RAD) gone amuck. I could barely learn to use the system, let alone develop a completed application before the upgrade was released. Frustration reigns supreme and has helped me arrive at the conclusion that RAD can also mean Really Annoying Demos, Release Ahead of Deadline (with or without bugs), and Running Away with Dollars.

*Joe DeMeyer
via the Internet*

A SINKING SHIP

In his column regarding the new desktop-operating-system initiative at IBM ("IBM: Déjà Vu, or a Second Chance?", August 1994), Michael J. Miller describes what seems to be an admission by IBM that OS/2, Version 2.1, is not just a commercial failure—it's a commercial failure that IBM is perfectly willing to let sink without a fight. Even though I am anticipating the arrival of IBM WorkPlace and its implementation of true software components, I am wondering whether the effort will be for naught, which will be the case unless IBM comes up with a more effective plan for tackling the Intel/Microsoft behemoth.

*Isaac Citrom
Montreal, Quebec, Canada*

STYLE CHECKPOINT

The review "A Strunk and White for E-Mail Writers" (Read Only, September 27, 1994) includes a sentence beginning "Since e-mail is conversational but not verbal. . . ." This relates to a pet frustration of mine. I've noticed this loose use of "verbal" quite a few times recently in a

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LETTERS

variety of contexts. All words are "verbal," since "verbal" communication by definition is communication using words. The author should have chosen "spoken" or "oral" instead of "verbal."

*Ed Cannon
via the Internet*

BUYER BEWARE

The article discussing software that turns your computer into a phone with call-forwarding and transferring capabilities (Trends, "Answer the Softphone!", September 27, 1994) fails to mention the potential for users to be caught in a scam. One company I know of was hit with a \$7,000 phone bill for long-distance calls to Colombia, plus a few hundred dollars for the hacker calling in on their 800 number to make the outgoing calls. If the proper safeguards are not in place to prevent this kind of hacking, the consequences can be financially devastating.

*Don Scott
via the Internet*

INSPIRING IMAGINATION

The First Looks review of Inspiration for Windows 4.0 ("Inspiration: Idea Development Tool for the PC," September 13, 1994) reveals a product with both promise and purpose. I found the author's suggestions that Inspiration might eventually be designed as an adjunct to word processing and as a front end for a "database of common ideas" provocative and fascinating to consider. A tool like Inspiration, with its visualization of subtle hypertext links, holds the potential not only for profoundly altering the way we process the current knowledge base but also for revolutionizing the very learning process itself, enhancing human cognition in ways that will heighten and enrich our lives.

*William B. Fankboner
La Quinta, California*

TURBOCHARGED REALITY

It should be noted that the Trends story "Hard Disk Turbochargers" (August 1994) reinforces a rapidly spreading marketing fallacy. "Enhanced IDE" disks fol-

low a proprietary spec used only by Western Digital Corp., while Maxtor Corp. and other manufacturers construct disks compliant with the industry standard Mode III IDE spec, a distinctly separate entity from Enhanced IDE.

*Bruce Bullis
Maxtor Customer Support
San Jose, California*

A BLAST FROM THE PAST

In John C. Dvorak's Inside Track column (August 1994), he states, "The last time there was a platform shift the big names in the desktop business computer scene were...Cromemco...and a dozen other companies you've never heard of since." Our compliments on mentioning Cromemco, and our complaints on the context. We have just completed our twentieth year in business, although, as Dvorak correctly implies, the last eight years have not been in the PC area but rather in high-end Unix-based systems. We now have been heard of (and from) since the "platform shift."

*Richard L. Moore
President and CEO, Cromemco Inc.
Newark, California*

IT'S ALL IN THE ENCRYPTION

In Jeff Prosise's Utilities column "WinCrypt Protects Your Data" (July 1994) and his Tutor column in the same issue ("How to Keep It a Secret"), Prosise says it's virtually impossible to reconstruct the password of WinCrypt because of the one-way nature of the cellular automata and the seeded random-number generator. However, it would be relatively simple to reconstruct the final 512-byte encryption key, a potential weakness that needs to be pointed out in WinCrypt.

*John Aarts
via the Internet*

• **For a further discussion of the potential security weaknesses and strengths in WinCrypt, including how files encrypted with WinCrypt may be broken, please refer to Prosise's follow-up Tutor column "How Secure Is Your Data" in the issue of October 25, 1994.—Ed.**

Prosise's articles on encryption were very informative, particularly in the de-

scriptions of the various methods available. It was precisely the kind of comprehensive treatment of a topic that I look forward to seeing more of in *PC Magazine*.

*William Condron
via PC MagNet*

CORRECTIONS AND AMPLIFICATIONS

The *PC Magazine* Service & Reliability scores for the AT&T Global Information Solutions Globalyst 600 PC ("90-MHz Pentium PCs: Pentium Powerhouses," September 27, 1994) should have reflected that the machine is produced by a newer business unit of AT&T comprised of what was formerly NCR Corp. The *PC Magazine* Service & Reliability scores for NCR were average in all three categories of reliability, repair service, and technical support.

The correct toll-free sales number for AudioFile and the retail version of its TalkWorks voice-messaging software (New & Improved, September 27, 1994) is 800-522-8346.

The correct toll-free phone number for Novex Technologies' RadioActive (First Looks, "Tune in With Your PC," October 11, 1994) is 800-725-8324. In the same First Looks column, the toll-free phone number for Verbex Voice Systems' Listen for Windows, Version 2.0 ("Listen 2.0: Vocal Command and Control for the PC") is 800-275-8729.

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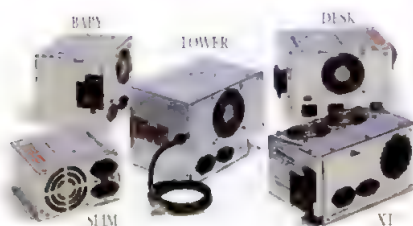
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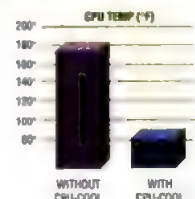
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Processors	Package 1		Package 2		Package 3	
	400C	800C	400C	800C	400C	800C
486SX-33	\$1995 Lease \$73/mo.	\$2295 Lease \$84/mo.	\$2295 Lease \$84/mo.	\$2495 Lease \$91/mo.	\$2595 Lease \$95/mo.	\$2795 Lease \$102/mo.
486DX2-50	\$2195 Lease \$80/mo.	\$2495 Lease \$91/mo.	\$2495 Lease \$91/mo.	\$2695 Lease \$99/mo.	\$2795 Lease \$102/mo.	\$2995 Lease \$110/mo.
DX4-100	\$2495 Lease \$91/mo.	\$2795 Lease \$102/mo.	\$2795 Lease \$102/mo.	\$2995 Lease \$110/mo.	\$3095 Lease \$103/mo.	\$3295 Lease \$110/mo.
Screen Options Meridian 400 Monochrome Option—VGA backlit LCD, 8.2" diag. (from 400C to 400) -\$300 Active Matrix Upgrade—VGA color backlit LCD, 7.8" diag. (from 400C to 400A) \$700 Meridian 800 Active Matrix Upgrade—VGA color backlit LCD, 9.4" diag. (from 800C to 800A) \$800	➤ 4MB RAM ➤ 175MB IDE hard drive ➤ 800C only: Internal 3.5" 1.44MB floppy drive ➤ MS-DOS 6.2		➤ 4MB RAM ➤ 260MB IDE hard drive ➤ 3.5" 1.44MB floppy drive, 400C: External, 800C: Internal ➤ Custom carrying case ➤ MS-DOS 6.2 ➤ Microsoft Windows for Workgroups 3.11 ➤ Lotus Organizer		➤ 8MB RAM ➤ 350MB IDE hard drive ➤ 3.5" 1.44MB floppy drive, 400C: External, 800C: Internal ➤ Custom carrying case ➤ Extra battery ➤ MS-DOS 6.2 ➤ Microsoft Windows for Workgroups 3.11 ➤ Lotus Organizer	

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Just push a few buttons, and hold the watch in front of your computer monitor. The screen will display some flashing bars of light, and in about 20 seconds the watch's little electronic eye will read as many as 70 entries from the

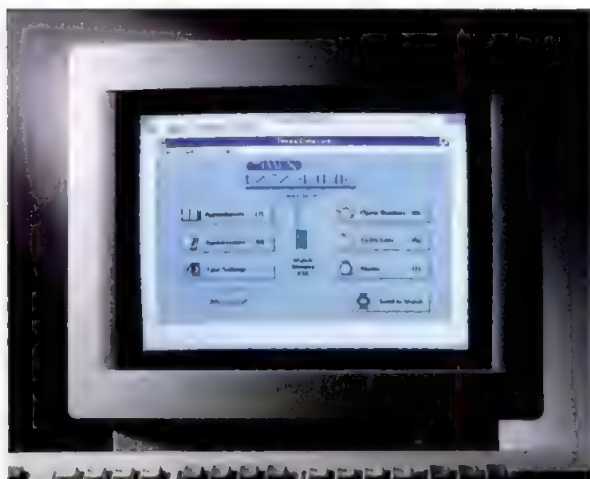
Microsoft and Timex Data Link software: appointments, phone numbers, alarms, to-do lists, birthdays and anniversaries. You can also easily import data from Microsoft® Schedule+ for Windows.™

Presto—all that information is now stored right there inside your watch, as portable as the arm you wear it on. You'll never forget another birthday or anniversary. A week before an

important date, a little hand with a string around the forefinger appears on the watchface (*Get outta here!*—no, really, it does) as a reminder icon. On the actual



're kidding me" scores ever recorded.



The Timex Data Link watch can actually read your personal information right from your computer screen.

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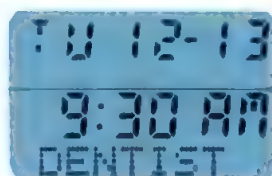
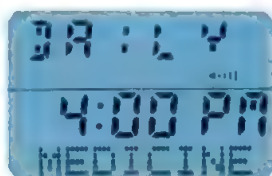
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user
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NEC

Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

Storming Intel's Castle

Innovative chips challenge the Pentium

Is Intel's x86 hegemony unshakable? AMD, Cyrix, and NexGen don't think so. They plan to go toe-to-toe with Intel's Pentium chips using innovative superscalar chip designs with RISC (reduced instruction set computing) operations and super-pipelined architectures. All three companies have devised technological marvels that have the potential to challenge Intel.

AMD has just released details of its 100-MHz contender, the K5. Due next year, the K5 will have a superscalar RISC architecture that AMD claims will deliver at least 30 percent better performance than a Pentium chip. The M1 from Cyrix and the Nx586 from NexGen are also positioned to challenge Intel (see First Looks in our issue of November 8, 1994 for an evaluation of the first NexGen-based PC).

The raging debate between RISC and CISC (complex instruction set computing) centers on the limitations of the small register set of the x86 design. AMD says it can fix that deficiency by using a RISC core that renames the registers on the fly for faster execution. RISC operations are then sent four at a time to be executed, while remaining compatible with Intel chips and with the nearly 50,000 DOS and Windows applications on the market.

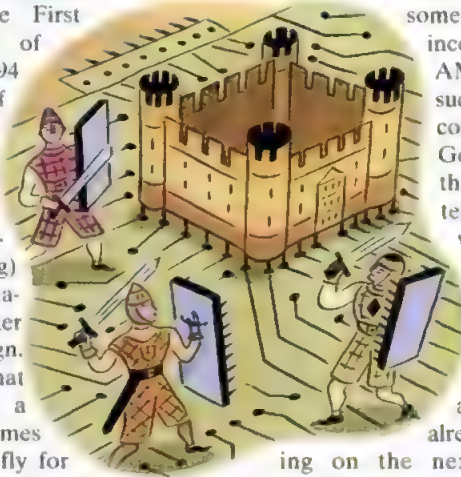
AMD, Cyrix, and NexGen also attack another problem known as *dependencies*. As instructions are being processed, they often

require the contents of a register whose information is unavailable or in memory. AMD, Cyrix, and NexGen use *branch prediction*, *speculative execution*, and *out-of-order execution* to resolve the dependencies. All claim to do this faster than the Pentium.

New architectures may scare some consumers who fear incompatibility, but AMD and Cyrix have a successful record of Intel compliance. And NexGen has put its chip through a battery of tests to ensure that it works with all major operating systems.

While 100 MHz seems to be the mark that AMD, Cyrix, and NexGen are all aiming for, Intel is already there and is work-

ing on the next two generations beyond Pentium. The P6, scheduled for late 1995, will have 6 million transistors, up from the Pentium's 3.2 million. And although it's hard to guess when the P7 may arrive, some sources already expect its replacement to come out of Intel's partnership with Hewlett-Packard by the year 2000.—*Christopher Barr*

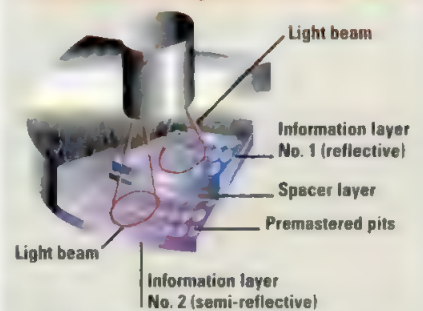


Full-Length Flicks On CD-ROM

WHEN WILL YOU BE ABLE TO BUY a 2-hour-long movie on a single CD-ROM? Sometime in 1996, predicts Jacques Heemskerk, program manager of the laser optics group of Philips Electronics N.V. in Eindhoven, The Netherlands. For the past year, engineers at Philips and 3M Software Media & CD-ROM Services in St. Paul, Minnesota, have been fine-tuning a new high-capacity CD-ROM technology that can store up to ten times more information than today's disks.

The 670MB capacity of CD-ROMs today seems like small potatoes compared with the 6.7-gigabyte-capacity CD-ROM that Philips has developed. The advances that make this work include short-wavelength red laser technology, which decreases the *spot* diameter of the light used to encode information onto the CD-ROM so that you can fit more into a smaller space.

Double-Layer CD-ROM



Short-wavelength red lasers can squeeze 6.7GB of information (over 4 hours of video) onto a dual-layer CD-ROM.

Sources: 3M and Philips Electronics

Add to that the double-layer design, and there's enough space for 4-and-a-half hours of video (compared with the 74 minutes you can get on a CD-ROM today).

Philips's Heemskerk predicts a gradual transition to these ultra-high-density disks. Since existing drives won't run the new disks, however, you'll need to buy a new CD-ROM drive. The new drives, however, will work with existing disks.—*Carol Levin*

Pipeline By Robin Raskin

Free Trials that I Can't Afford

This past year has been a remarkable one for America Online, as we tripled our subscriber base and passed the one-million-member milestone."—Steven Case, America Online, September 7, 1994

Twenty-five million people on the Internet; 1 million on America Online; 2.3 million on CompuServe; and 2 million on Prodigy. I think I've figured out how the commercial service providers get these numbers: They do everything but air-drop disks with free trial subscriptions onto unsuspecting on-line wannabes. Then, after luring people with the bait of free usage, they make it tougher than it should be to cancel the trial subscription.



Maybe you've tried one of the "10 free hours" disks that AOL plastered into every computer magazine a few months back, or you've gotten a month's free usage on Prodigy or CompuServe with your last modem or PC. The scenario goes like this: When you register for your free session you supply your name, address, and credit card number. Right then, any sane person should start wondering why these services demand a credit card number.

In your zeal to get onto the service, you forget to think about how in the world you're supposed to know when your free time has run out. I haven't yet met a person who kept a usage log (well, actually I know one, but he doesn't count as sane). Nor have I met a person who was notified that the free ride was up, either. There you are, cavorting through cyberspace, oblivious to

the ticking of the on-line clock, and the next thing you know you've got a bill in the mail for the ride. In most cases, trying to extricate yourself from your on-line folly turns into its own comedy of errors.

Prodigy suggests that you notify them by e-mail if you want to cancel but suggests that you keep a printout of your note, just in case. AOL lets you call a toll-free number or write to them via "snail mail." They suggest that if you're worried about the time limit you can type BILLING as your keyword and check your own usage. CompuServe claims that its customer service reps will let you cancel immediately.

Meanwhile, at *PC Magazine*, we always have some staff member working to get out of unwanted on-line subscriptions; it's a time sink. One journalist confided that it's easier to put the service fees on his expense account than to try to halt the billing, which seems to take on a life of its own. We received mail from a reader who, after failing to get the provider to credit his account for charges after he canceled, said his ultimate solution was to get a new credit card.

The free-trial model is not unprecedented. I'll bet you've been a member of a book or record club where you've been baited with wonderful incentives and the "no purchase required" line. I can forgive these lower-tech scams, but I expect more of high-tech service providers because they've got technology that should make this a nonissue. If they can monitor log-ons, passwords, and even the language you use on-line, you'd think they could find a way to monitor usage and inform you when your free trial is up.

I'm all for free lunches, but please tell me when the meal is over. I can't afford the tab.

Robin Raskin is the editor of PC Magazine.

Native Signal Processing Sets the Stage For Better Video and Sound

You're in the middle of a videoconference when the phone rings. Your telephony software picks up, takes the message, and runs it through voice recognition, converting the spoken word into text as the caller speaks.

Today, you'd need a digital signal processor chip on your system before you could even think about handling this job. But now that software developers are starting to get their hands on a technology that extends the PC's multimedia and communications capabilities, this scene may not be so farfetched.

These applications and others that are time critical have one thing in common: They need to get to and process live data as it happens. "As we start moving into applications that process *real-time* information, you need to guarantee that the processor can get the information as its coming in," says Dave Schuler, marketing manager at

Intel Architecture Labs in Hillsboro, Oregon. One of the first steps toward bringing a real-time operating system to the PC is a recent agreement between Intel and Spectron Microsystems. Spectron has developed a real-time OS called Spox, which Intel plans to incorporate into Pentium processors. Today Spox runs on digital signal processor chips.

Intel expects this move to drive the development of a new class of applications based on *native signal processing (NSP)*, a term Intel coined to describe the ability of Pentium systems to process audio, video, and communications information in the CPU without requiring digital signal processing (DSP) chips or add-in cards. Intel says the technology should also drive down the cost of multimedia and communications on the PC.

Audio apps will be the first to benefit

from NSP. For example, you'll be able to lock or unlock a database application by speaking to your PC, mix and use a text-to-speech application to generate smooth speech, or mix and scale multiple audio streams. A complex application like videoconferencing will compress and decompress the video and audio streams on the processor rather than the video accelerator.

To get the ball rolling, Microsoft plans to release the DSP Resource Manager Interface (RMI), a tool developers can use to write Windows programs that execute these kinds of tasks in real time. With RMI, software programmers will have a single design model to write programs to, a simpler approach than writing programs to work with an assortment of DSP chips. The cost of add-in cards should also drop, predicts Schuler, as the CPU will handle most of the processing and the add-in card will be used only as a connection to the outside world.

Later this year, Spectron and Intel plan to hold a developers' conference where software makers will have an opportunity to experiment with the new technology.

—Carol Levin

Notebook Swallows CD-ROM Drive!

NOTEBOOK PCs WITH INTEGRATED CD-ROM drives were the next logical step in the evolution of the portable PC. So what took so long? According to the notebook makers, engineers first had to work out a



With the new Panasonic CF-41, you can have your CD-ROM drive and floppy disk drive, too.

number of design problems. "Our primary concern was to keep the notebook's form factor down in size," says John Harris, national marketing

manager for Panasonic Personal Computer Co. "The trick was to design a drive that would fit into a notebook without altering its features or adding a lot of excess weight."

So what sacrifices did developers make in

designing portable multimedia PCs? Some manufacturers decided to remove the built-in floppy disk drive to make room for the CD-ROM drive; some are trying other solutions. By designing a thin CD-ROM drive for its 8-pound CF-41 Multimedia Notebook, Panasonic was able to stow the CD-ROM under the keyboard without displacing the internal floppy disk drive—and still have room for a storage rack that holds an extra CD-ROM.

IBM takes a different approach with its upcoming ThinkPad 755CD. Access to the CD-ROM drive is in the front where you normally find the floppy disk drive, and the CD-ROM drive and floppy disk drive are interchangeable. "The reason for this design is twofold. We already had the space available since the original 750 was designed with a removable floppy. And we wanted our CD-ROM drive to be as familiar as possible to operate," says



With the IBM ThinkPad 755CD, you can exchange a 3.5-inch floppy disk drive with a double-speed CD-ROM drive.

IBM's Jonathan Gandall. MPC Computer made the floppy disk drive external to make room for an internal CD-ROM drive. The drive unit is underneath the keyboard, but there's no bay to store an extra CD, and the motherboard is exposed whenever you want to change the CD.

All three designs still face one glaring problem: battery life. A system with a CD-ROM drive that draws power, coupled with

an active-matrix screen and a high-speed processor that draw power, may give you a portable multimedia machine, but your presentations had better be short.

Philips Electronics is already working on the power problem. The company is developing a smaller CD-ROM drive that measures less than 15 millimeters high and draws only 2 watts of power.—*Tin Albano*

DCI: The Secret to Digital Video Speed

IF YOUR WINDOWS APPS START TO run faster (and maybe the kids start to eat their vegetables, too), it's not your imagination. There is an explanation. Intel and Microsoft have developed a new device driver specification called DCI (Display Control Interface), which promises to run Windows apps faster and to speed video playback.

Normally, Windows applications rely on Windows' GDI (Graphics Device Interface) to handle video and graphics functions. But when you're running graphics-intensive games and multimedia applications, your PC's CPU can become overloaded. DCI works as an arbitrator, relieving the CPU load by moving certain graphics and video-intensive jobs to the graphics card for faster processing—20 to 50 percent faster, depending on your system, says Intel.

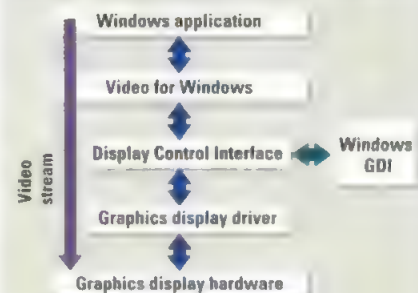
For this process to work, your graphics drivers and operating system must be DCI-enabled. The DCI Manager in Windows 95 will check to see how busy the hardware components are. If the graphics function is a quick, easy one and the graphics card is free, the DCI Provider will handle these functions directly on the card. Otherwise, the DCI Manager will pass the work order over to the Windows GDI.

To optimize DCI fully so that it's handling multimedia functions on the graphics

card, your card must support the myriad features that DCI can manage. The next generation of DCI-enabled graphics cards will support image scaling, color interpolation, and color-space conversion. We'll evaluate

Video Traffic Pattern

With DCI-enabled hardware, a Windows app can send and receive video information directly from the source (Video for Windows in this case) to the screen and bypass the Windows bottleneck.



the first of these DCI-enabled graphics cards in our next issue.

Most application programs don't need to be DCI-enabled. Codecs and other multimedia software, on the other hand, do need DCI hooks. Intel's Indeo video compression program, for example, is now DCI-enabled.—*Kathleen Caster*

Top Retail Software

Current ranking	Last issue	Product/company
1	1	MS-DOS 6.22 Upgrade Microsoft Corp.
2	8	WinFax PRO 4.0 Delrina Corp.
3	2	Procomm Plus for Windows 2.0 Datastorm
4	4	MS Windows 3.11 Microsoft Corp.
5	—	QEMM 7.0 Quarterdeck Office Systems
6	—	WINCheckIt 2.0 TouchStone Software
7	—	Quattro Pro 5.0 for Windows Borland International
8	—	Visio 3.0 Shupeware Corp.
9	—	Ami Pro 3.1 Lotus Development Corp.
10	—	MS Works 2.0 for Windows Microsoft Corp.

This list ranks PC business programs according to the total number of copies shipped to over 12,000 stores and resellers in the week ending September 17, 1994; the list cannot be interpreted as a picture of the entire software market. Adapted from a compilation by Ingram Micro.

Trends

Develop Your Own PC Games

WE HAVE A SUGGESTION FOR THE child who constantly complains of boredom. Europress Software, a small company in England, has developed a program that lets you create your own computer games. Klik & Play guides you through the process of building complex action, adventure, logic, racing, and educational games. The program will be distributed by Maxis (510-254-9700).

Using a storyboard editor as the interface, you (or your child) compose the different levels of play by choosing characters and backgrounds from hundreds of choices. You

can also add your own .EPS, .PCX, or TIFF graphical images.

Each object comes with its own set of properties that control how it moves or reacts. For example, if you don't like how a character crawls, you can use the animation editor to change its behavior. An event editor controls how the objects interact with one another and how you can control them with the keyboard or mouse. Using point-and-click menus, you can make the object throw something (like a fireball), explode when hit, move out of the way, or disappear.

As you create the game, you can test it by stepping through the different levels and making changes. When it's complete, you can save a runtime version of the game so others can play it.

The skill needed to create a game with



With Klik & Play you design adventure by assigning properties to objects and logic games.

Klik & Play is above the level of the elementary student, but the amount of creativity it offers will challenge kids of all ages.

—Christopher Barr

Multimedia Chip

THE FIRST CHIP WITH THE GUTS TO do multimedia without sacrificing speed comes not from the Intel-compatible arena but from the Sun workstation world. The graphics processing power of the new high-performance 64-bit UltraSPARC processor may obviate the need for add-in cards for video and graphics functions and reduce the cost of future workstations.

Now under development at Sun Microsystems' SPARC Technology Business unit, UltraSPARC is the first RISC processor with an entire suite of instructions (over 30)

and decompression of MPEG-2 video streams and will support 2-D and 3-D image processing and video effects. Sun even claims that UltraSPARC will be able to decode two simultaneous MPEG-2 streams at 30 frames per second while concurrently processing video effects.

The first UltraSPARC processor will be based on a 0.45-micron design. It will operate at 3.3 volts and will have all the latest super-scalar features for processing more than one instruction per clock cycle, including four-way

instruction issue, speculative execution, out-of-order completion, and dynamic branch prediction. In addition, special block load/store commands will enable the chip to read or write 64 bytes at a time directly to or from main memory, bypassing the L1 data cache entirely during data-intensive operations such as video processing.

Existing 32-bit SPARC software will run unchanged on the new chip, but developers need to recompile software to take full advantage of the chip's 64-bit features.—Nick Stam

Briefs

UltraSPARC: Programmed For Graphics

UltraSPARC supports a full set of specialized graphics commands to optimize throughput for graphics-intensive applications.

Instructions

- Pixel expand
- Pixel packing
- Pixel merge
- Partitioned add/multiply/compare
- Align
- Edge handling
- Array addressing
- Pixel distance

Source: Sun Microsystems' SPARC Technology Business.

designed to accelerate multimedia processing. Late next year, Sun expects to offer the first systems that will run at clock speeds ranging from 140 MHz to 200 MHz. Texas Instruments will manufacture the chip at its billion-dollar, million-square-foot fabrication complex in Dallas.

Occupying only 3 percent of the chip's surface, the Visual Instruction Set will assist software in performing real-time compression

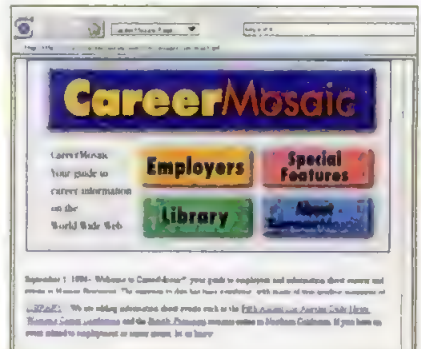
SCIENTISTS AT MATSUSHITA'S CENTRAL

Research Laboratories in Osaka, Japan, have demonstrated a new computer memory technology that can store the contents of a CD-ROM on a tiny dot. Using an atomic-force microscope that stores data on the CD-ROM material at the molecular level, the technique can squeeze one bit of data into a space that measures one-hundredth of a micron in diameter. That's more than a thousand times the capacity of existing disks.

BUSINESSES ARE CREATING INTERNET

identities by setting up their own World-Wide Web servers and by joining CareerMosaic, a new World-Wide Web site (<http://www.careermosaic.com>) that posts multimedia brochures and recruitment information from companies such as Intuit, National Semiconductor, and Sun Microsystems. For details on creating an Internet identity for your compa-

ny, contact Bernard Hodes Advertising at 212-758-2600.



PRICES OF PENTIUM PCs ARE PLUMMETING

as manufacturers introduce 90-MHz Pentium PCs costing between \$2,000 and \$2,600. This represents a drop of between \$1,400 and \$1,800 from introductory prices earlier this year, reports Computer Intelligence/InfoCorp.—Carol Levin

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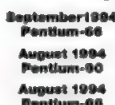
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PC World Best Buy



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Windows Sources Experts' Pick



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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

Printers

Four Laser Printers That Make a Mark

BY ALFRED POOR

PC Magazine's blockbuster printer issue is rumored to drive the timing of the development schedules at more than one printer company. Even so, there's always a handful of machines that don't ship in time to make it into the main review story featured in this issue. This year, the late arrivals include four laser printers—three from Lexmark and one from Apple—as well as a color ink jet printer from Tektronix (see sidebar).

The four laser printers that follow cover the full range of laser printer missions, from a \$600 easy-to-use personal printer to a \$2,400 multifunction powerhouse better suited for high-speed network assignments. No matter what type of printer you're shopping for, compare these late arrivals with those in the printer issue before deciding.

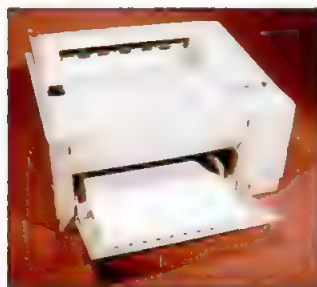
LEXMARK WINWRITER 200 AND WINWRITER 400

The two Lexmark offerings have a lot of similarities, including low list prices, an easy-to-use design, and the Microsoft At Work (MAW) printer software. The WinWriter 200 and 400 are personal laser printers; the next step up is the WinWriter 600, which is reviewed in the main printer story.

The MAW package provides a graphical interface for the printers. Unlike most printers, these Lexmark units have no control buttons, so configuration

and control are accomplished through the Windows software that resides on your PC. MAW also reports the printer's status to your computer, letting you know when attention is needed (such as when there is a paper jam or if the printer is out of paper or toner). There is even an on-screen diagram that shows the progress of paper as it moves through the printer. Both Lexmark printers include power-management software and are Energy Star-compliant.

The similarities end there. The \$579 WinWriter 200 is



ENTRY LEVEL: The WinWriter 200 is ideal for Windows users who want a low cost printer that's easy to use.

based on a 300-dot-per-inch laser print engine that is rated at up to four pages per minute. It comes with 22 TrueType fonts and 512K of memory, expandable up to 4.5MB. The one-piece, \$147 toner/drum cartridge is rated at a lifetime of 4,500

Continues on page 38

Spreadsheets

Quattro Pro 6: Substance and Style of Spreadsheets

BY CRAIG STINSON

In its first appearance under the Novell corporate umbrella, Quattro Pro for Windows has taken on a new mission in life: to be a good mate for its sibling applications in Novell's forthcoming PerfectOffice 3.0.

To that end, Quattro Pro now supports OLE 2 as both a server and a client. You can drag and drop data between your spreadsheet and other OLE programs, and you can edit embedded objects in place. The program also supports in-place

editing of its own graphs and OLE automation.

Quattro Pro for Windows is not meant to operate in a vacuum. It includes what Novell calls Obex, which allows Quattro Pro to publish worksheet data at multiple revision levels to subscribers via a variety of routes, including e-mail (MAPI, VIM,



LOOKALIKE: Quattro Pro for Windows' menu bar has been redesigned to resemble other members of the PerfectOffice suite.

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MHS, NGM, and MCI Mail), or over a local area network. While Obex made its debut in Version 5.0 of Quattro Pro, Version 6.0 adds the ability to attach worksheets to mail messages directly. Given the complexity of Obex setup and the fact that not everyone needs publish/subscribe automation, this is a welcome improvement.

FRESH BRIGHT FACE

Most important, however, Novell has given Quattro Pro a top-to-bottom interface makeover. At the top, the redesigned menu bar closely resembles the one used by WordPerfect for Windows; the first three and last four menus are identical, making the WordPerfect user feel right at home.

Nearly gone (they still show up in a few places) are the Borland-style dialog boxes with their big red and green controls.

Continues on page 40

First Looks

Laser Printers

CONTINUED FROM PAGE 37

pages assuming 5 percent page coverage; per page cost is 3 cents. The input paper tray holds up to 150 sheets of paper, and the output bin is rated to hold 50 sheets—though we found in testing that pages started spilling off the printer annoyingly often well before reaching this capacity.

Print quality for the WinWriter 200 was good compared with the other 300-dpi laser printers reviewed in this issue.



BALANCE: A midpriced personal printer, the WinWriter 400 provides a good balance between print quality and performance.

The Lexmark WinWriter 200 supports PCL 4 emulation, but only running in a DOS window within Windows. And the results are so painfully slow that it should be viewed only as a convenience. The printer managed just 2.0 ppm on our Text Speed test and 0.7 graphics pages per minute (gppm) on the Graphics Speed test. Under Windows Write, it printed the same text files at 3.6 ppm. Another reason to stick to Windows for printing with this WinWriter is that the PCL 4 emulation has some flaws, including the inability to correctly print some shade patterns.

The \$899 WinWriter 400 is based on a 5-ppm 300-dpi laser print engine that claims to produce "600-dpi quality" resolution using enhanced resolution techniques. The base model comes with 44 TrueType fonts and 2MB of memory (expandable to 6MB).

The one-piece toner/drum

cartridge costs \$114 and has a rated life of 3,500 pages at 5 percent coverage, which works out to a 3 cent per-page cost. The printer can hold more paper than the WinWriter 200 with its 150-sheet input tray and a 150-sheet output bin.

The print quality of the WinWriter 400 was good for a 300-dpi printer but was still not quite up to the edge sharpness and smooth transitions that a true 600-dpi system affords. As is the case with many other Lexmark models, there is a tendency for dark areas to print too



SPLIT PERSONALITY: Priced low enough to be a single-user printer but with the horsepower for a workgroup, the Optra L can fill a number of roles.

dark. The Text Speed test result was 4.3 ppm and the Graphics Speed test result was 0.8 gppm. The speed penalty for PCL 4 was not as severe with the 400; under Windows Write, the text speed was 4.7 ppm. Overall, the WinWriter 400 is a personal printer that balances speed and price.

► **Lexmark WinWriter 200.** List price: \$579. **Lexmark WinWriter 400.** List price: \$899. Lexmark International Inc., Lexington, Kentucky; 800-358-5835; 606-232-2000; fax, 606-232-2380.

Circle 432 on reader service card.

LEXMARK OPTRA L

If you're looking for a workgroup printer or if you want a printer with more horsepower than the typical personal printer, consider the 1,200-dpi Optra line of Lexmark printers. The Optra R and L models are rated at 12 ppm, and the Lx model has a 16-ppm rating. We tested the \$2,299 Optra L with an optional 8MB

of extra memory, which costs an additional \$499.

All Optra printers come with PCL 5 and PostScript Level 2 as standard features. Be aware that both are emulations, though we found no compatibility problems during testing. The Optra L has front-panel controls and a four-line LCD message panel. The control buttons are not labeled; instead, functions are displayed on-screen the way they are on an automated bank teller machine. You use the front panel to change the printer's configuration.



GROUP PRINTER: The network-ready LaserWriter can accommodate a fax feature, making it a multifunctional printer.

The Optra L comes with MarkVision remote-control software. This Windows program displays the printer's message window and on-screen buttons. Since you can use this feature on printers attached to a network, it makes controlling a printer a snap, even if it's down the hall.

Print quality was generally extremely good with the Optra L, though under PCL 5 emulation line thickness varied and there was a tendency for dark images to be too dark. There is a choice between toner cartridges: The \$199 cartridge is good for 7,000 pages and the \$295 cartridge can print on 14,000 pages, making per-page costs 3 cents and 2 cents, respectively.

Print speed varies with resolution: At 1,200 dpi, the PCL 5 text speed was 7.1 ppm, but at 600 dpi, it was 13.5 ppm—faster than rated. Under PostScript, 1,200-dpi text was 7.2 ppm, but

13.8 ppm at 600 dpi. At 600 dpi for graphics, the PCL 5 result was 3.4 gppm, and for PostScript it was 1.5 gppm.

All told, these are excellent results for a printer in this class. Add in the stunning quality of the PostScript 1,200-dpi prints and you have an all-around office workhorse or a powerful personal printer.

► **Lexmark Optra L.** List price: \$2,299; 8MB upgrade, \$499. Lexmark International Inc. Lexington, Kentucky; 800-358-5835; 606-232-2000; fax, 606-232-2380.

Circle 433 on reader service card.

APPLE LASERWRITER 16/600 PS

If you want a printer that is a jack-of-all-trades, then the Apple LaserWriter 16/600 PS may be what you need. This printer lists for \$2,429, comes ready for network connection, and even has an internal send/receive fax option.

The 600-dpi laser engine is rated at 17 ppm and has enhancement modes for both text and graphics. The 25-MHz RISC processor drives a controller that accepts PCL 5 and PostScript Level 2 with automatic mode switching, and has simultaneously active parallel, Ethernet, and LocalTalk ports. There is also a SCSI port for an optional hard disk should you need additional local font storage space.

The printer has a 250-sheet paper cassette, a 1,200-sheet multipurpose input tray, and comes with 8MB of memory; our evaluation unit was upgraded to 16MB, along with the fax card. The fax option (\$309 list price) lets your printer receive faxes directly from Group III or PostScript fax machines, and you can also fax print jobs. All you need is a phone line and the Apple LaserWriter 16/600 PS does the rest; cost is 2 cents per page.

Print quality was nothing short of excellent, with smooth graphics and solid black areas. In PCL 5 mode, the LaserWriter

First Looks

16/600 PS appears to print at only 300 dpi, so for best results, plan on using PostScript at 600 dpi with enhancement enabled. For text speed, the 16/600 PS turned out 14.3 ppm in PCL 5 mode and 14.5 ppm under PostScript. For graphics, the PCL 5 speed was 3.2 gppm; under PostScript (at 600 dpi) it was 1.4 gppm. This printer is both fast and flexible.

► **LaserWriter 16/600 PS.** List price: \$2,429; fax option, \$309. Apple Computer Inc. Cupertino, California; 800-538-9696; 408-996-1010.

Circle 434 on reader service card

THE RIGHT CHOICE

Which printer makes the most sense for you depends on your needs and pocketbook.

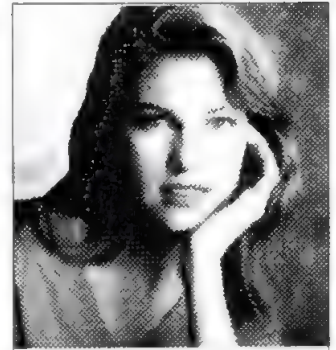
Compare the four laser printers reviewed here with those included in the printer review section of this issue to get the most up-to-date survey of the laser printers available. If you're looking for basic functionality and reasonable print quality in an inexpensive laser printer that will operate in a Windows environment, the

Lexmark WinWriter 200 should satisfy. A step up the Lexmark ladder is the WinWriter 400, which is faster, has better-quality output, but also costs over \$300 more. Its enhanced 300-dpi printing is a good approximation of higher-resolution printing but is no substitute for a true 600-dpi printer. The Lexmark Optra L and the Apple LaserWriter 16/600 PS are clearly a cut above in terms of resolution and throughput. Today's laser printer market offers a plethora of choices, with an ideal unit for every need.

COMPARE: The laser print samples of a typical photo and gray scale show a range of technologies and price tags. The WinWriter 200 is aimed at the desktop and manages good quality output; the WinWriter 400 produces sharper type and graphics; Lexmark's Optra L is fast enough for shared use, and its 1,200-dpi technology can produce camera-ready type-setting; the Apple LaserWriter 16/600 PS consistently produces crisp 600-dpi pages.



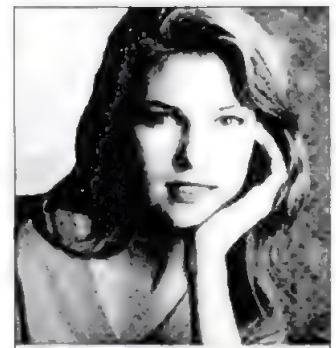
Lexmark WinWriter 200



Lexmark WinWriter 400



Lexmark Optra L



Apple LaserWriter 16/600 PS

■ Tektronix Phaser 140: Affordable High-Quality Color

There's a new entrant in the increasingly crowded color ink jet printer market: the Tektronix Phaser 140. With a list price of \$1,695, it is a competitive alternative to the Hewlett-Packard 1200C.

The printer is built on a 360- by 360-dpi color ink jet print engine from Canon that uses BubbleJet technology. Tektronix

and LocalTalk ports are standard, and you can add an Ethernet interface, as well. All three ports can be simultaneously active, making it easy to share the printer among multiple users.

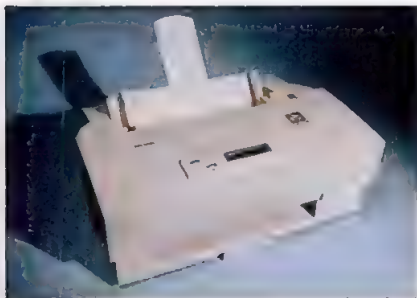
The printer uses four separate ink cartridges—black, cyan, magenta, and yellow—so you can replace only those cartridges that are empty. The input tray holds up to 100 sheets of paper at a time, and you can get excellent results on plain paper, though the printer also works with coated stock and transparencies.

During testing, the Phaser 140's output quality was excellent. Colors are well saturated but fall short of the garish neon glow achieved by some other ink jet printers. The 360-dpi output makes it possible to create fine dither patterns, so gradient fills are smooth and clean. The printer is rated at "up to 2 pages per minute" in black and white, though it took more than a minute and a half for our Graphics Speed test to print a sheet.

Whether you are looking to print charts and graphs or photographs, the Phaser 140 provides a PostScript printer that does an excellent job at a competitive price.—AP

Phaser 140. List price: \$1,695. Tektronix Inc., Wilsonville, Oregon. 800-835-6100; 503-682-7377; fax, 503-682-7450.

Circle 437 on reader service card.



PAINT BY NUMBERS: The \$1,695 Tektronix Phaser 140 produces stunning 360-dpi prints.



includes Adobe PostScript Level 2 support, driven by a 16-MHz RISC processor and 8MB of memory (expandable to 24MB). The printer also comes with 17 resident outline fonts. Parallel

Quattro Pro 6.0

CONTINUED FROM PAGE 37

The majority of Quattro Pro's dialog boxes look similar to those used by many other Windows programs. For file management, however, Quattro Pro will use WordPerfect's dialog boxes, provided the latter program is installed. The highly regarded WordPerfect file-management services will let Quattro Pro users index their worksheets for fast text retrieval, which no other spreadsheet currently provides.

Just above the worksheet sits a new property band, comparable to the status bar that runs along the bottom of Lotus 1-2-3 for Windows. The property band provides left-click alternatives to Quattro Pro's right-click

object inspectors. You can still use the object inspectors to set formats, fonts, and other attributes, but the property band will often prove quicker. The drop-down items change to reflect the current context, and, of course, the band itself looks just like the one found in WordPerfect.

The biggest visual change lies between the property band and the menu bar. Here, the double toolbar of Quattro Pro for Windows, Version 5.0, has been replaced with a single toolbar, and the chunky Borland icons have given way to a softer, grayer, more conventional looking set. Rest the mouse on an icon and you get a short descriptive legend, plus a WordPerfect-style verbose description on the window's title bar.

The reorganized user inter-

face should satisfy PerfectOffice's citizenship requirements, and the aesthetic redesign will reassure potential corporate

adopters who may not have felt at ease with Borland's brash and defiant visual style. This break with the past is risky, because Version 6.0 provides no option to restore its predecessor's menu tree (as, for example, Microsoft Excel, Version 5.0, does) and existing macros that access

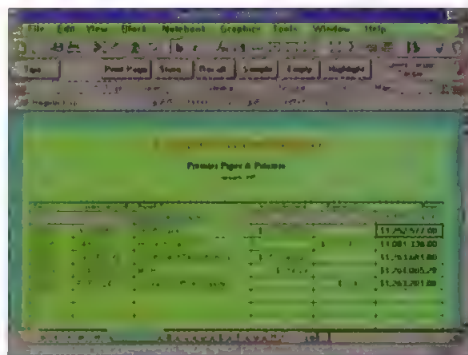
Quattro Pro's menus via keystroke sequences will have to be rewritten. Novell points out, correctly, that menu-equivalent macro commands work fine in Version 6.0, and that Quattro Pro's macro recorder always generates these commands, rather than keystroke sequences.

Quattro Pro now permits direct date entry, without the Shift-Ctrl-D prefix required by Version 5.0. For example, you can now type 11/12/94 and the program will display a date instead of a quotient. As a result, all formulas (other than those that begin with a function call) must now start with a plus, minus, or equals sign.

On the analytic front, Version 6.0 makes no major advances, but it remains ahead of the competition in particular areas. If you need an exotic calendar, engineering, or financial function, you're more likely to find it in Quattro Pro than any other spreadsheet. Novell has also strengthened Quattro Pro's presentation features. A new drawing layer lets users annotate worksheets with circles, arrows, and whatnot.

The slide-show facility now has master-slide capability, where you can choose from a gallery of masters or build your own; there is also an easy-to-use tool for generating two-level bullet charts. The Presentation

Advisors, an add-in for Quattro Pro for Windows, Version 5.0, has been effectively incorporated into the product, providing



EASY-START: The File New command provides access to seventeen templates for many common spreadsheet applications.

useful guidance for slide and graphics styling.

While offering no new chart types, Version 6.0's default chart selection seems less intelligent than Version 5.0's. For example, select a 1,000-row block consisting of a column of dates next to a column of numbers, and by default you'll get a thousand-slice pie chart, complete with an illegible smear of overlapping labels. But you can now use some attractive new three-dimensional markers, and bitmaps applied to chart walls or backgrounds can be tiled.

A smattering of other changes, including in-cell editing, the provision for attaching templates to the File New command, and a new Formula Composer to help you understand function syntax and decode complex formulas, are sure to appeal to long-time Quattro Pro fans. The crucial changes in this update are as much a matter of style as of substance. Novell has made Quattro Pro for Windows a well-dressed, well-behaved member of the WordPerfect family.

► **Quattro Pro 6.0 for Windows.** List price: \$395. Requires: 4MB RAM, 24MB hard disk space, Microsoft Windows 3.1 or later. WordPerfect, the Novell Applications Group, Orem, Utah; 800-451-5151, 801-225-5000.

Circle 438 on reader service card.

Getting the Right Formula

Quattro Pro's new Formula Composer is designed to help you thread through the complicated syntax of the program's vast function library. You can use it both for building new formulas and for deciphering something that someone has laid in your lap.

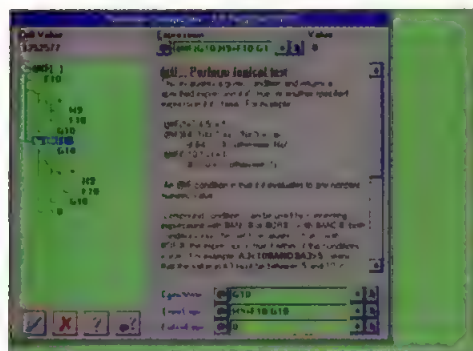
Start by selecting a cell, click

node is currently selected in the left pane. Each expression in your formula is an outline node. If the expression is itself a function, Quattro Pro uses a folder icon to represent the node. Double-click the folder, and the outline expands to show that function's arguments, and so on. Eventually,

by traversing the outline, you can work your way down to the level where everything is a numeric constant, a text constant, or a cell reference.

At any point in the outline, a value box shows you what the current node would return were it entered into the spreadsheet by itself. Text boxes, help buttons, and

examples assist you in entering and altering the contents of the current node. Two help buttons provide more details about the Composer or any function.—CS



COMPARE: The Formula Composer shows you the current value and syntax requirements for any expression

the formula composer icon, and you get a two-paneled window. The left pane displays a two-level outline of your formula. The right pane displays information about whatever

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Is the Cyrix 386-to-486 Upgrade Chip really that good? Just ask anybody.

66

"Simply plug in the Cyrix 486 upgrade to a 386 motherboard and you'll crank up performance by better than 60%..."

-PC Computing, November 1993

"True to the company's word, we found Cyrix's DRx² an easy upgrade that can deliver a performance boost (to your) wheezy old 386."

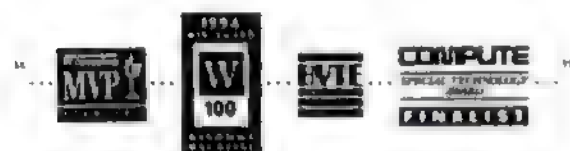
-Computer Shopper, February 1994

"This Cyrix upgrade is easily fitted in 15 min, and then the user is up and running with all the old software and data files unaffected. There is no learning curve or disruption for the user—it is only necessary to get used to the fact that the computer does everything twice as fast as before."

-Personal Computer Magazine (UK), November 1993

"The Cyrix Cx486SRx² 386SX upgrade chip cleverly does something which everyone thought was impossible...a single-chip upgrade for 386SX machines.."

-Personal Computer Magazine (UK) January 1994



"Priced at under \$300, the upgrade will nearly double the performance of that creaky old 386SX a few of you still use."

-PC Magazine, February 8, 1994

"Cyrix's clever design makes it possible to upgrade nearly any 386 in existence, without hassle or high cost...All you need is a fast, affordable upgrade for an office of 386s. The Cyrix Cx486SRx² is it. Just plug it into your s386 system and go."

-PC Computing, December 1993

"Cyrix's solution is simple. You remove the existing 386 chip from its socket, plug in the Cx486DRx² and run some software."

-PC Magazine, October 13, 1993

"Cyrix has developed inexpensive upgrade chips for 386-class personal computers...and the effect will be like dropping a Corvette engine into a Ford Escort...We decided to try one of the Cyrix chips. The result was impressive...Think about how much a small company could save."

-Barry Cooper, The Orlando Sentinel February 10, 1994

"Another potentially interested Cyrix customer is the corporate buyer... The buyer's budget can't handle 20 new 486-class PCs, and there isn't the time to do motherboard swaps on all of them, either. Enter Cyrix and the quick-and-easy 40-65 percent performance-boost solution."

-Computer Shopper, February 1994

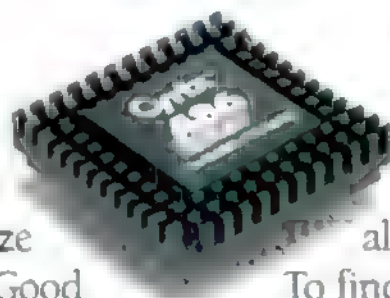
"...dropping in a Cyrix Cx486DRx² Upgrade Microprocessor is a quick way to really push performance."

-WordPerfect the Magazine, December 1993

"...Cyrix gives new life to older 386SX- and 386DX-based computers...This may be the best upgrade solution we've seen yet for users of older machines who don't want to shell out \$1,500 or more to move into a new 486-based system."

-Windows Magazine, The Win 100 The Best Windows Products of the Year February 1994

99



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■ Image Editing

Picture Publisher 5.0: Photo Flexibility

BY LORI GRUNIN

Every update of Micrografx Picture Publisher has a few new tricks up its sleeve, and Version 5.0 (\$595) is no exception. Combined with a variety of catch-up additions and interface enhancements, PP's set of new-found capabilities—such as editable command stacks—render Picture Publisher an even more formidable image-editing program than ever before, and potentially the most flexible product in this market.

The Command List idea is simple but yields extremely powerful results: As you work, the program tracks each individual operation—including brush strokes and transformations—and saves the commands and parameters as a small file. At any time, you can view the list of operations and reorder, delete, or undo any of them. You can even save the Command List of operations done to a low-resolution image as a macro and apply the operations to a higher-resolution version of the image.

NEAR LIMITLESS VERSATILITY

The Command List allows flexibility that goes beyond the mere undo functions of other programs. For instance, one complicated image we created required several operations, including an unsharp masking, a saturation increase, and the application of special effects.

We were able to backtrack and change the color saturation after applying a special effect, then reorder the operations in the Command List and let

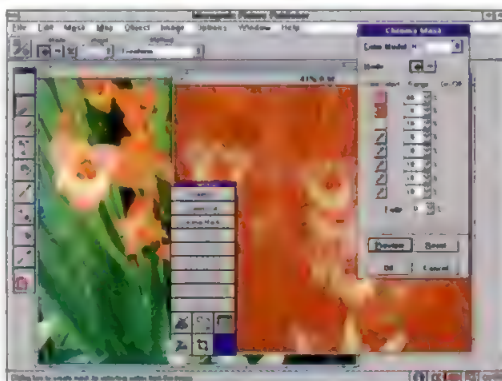
Picture Publisher rebuild the image with the new parameters. Alternatively, we could have inserted new operations into or taken existing operations out of the Command List at any point, creating a different final image.

Working on a 100-pixels-per-inch (ppi) file, we generated a

a resolution that is a multiple of the resolution of the higher-resolution analog. And finally, every time you re-order the stack or undo beyond the last step, Picture Publisher regenerates the image from scratch, yielding long rebuild times.

CATCH-UP

Micrografx has done its best to catch up with other image editors. You can finally create and edit masks using Bezier



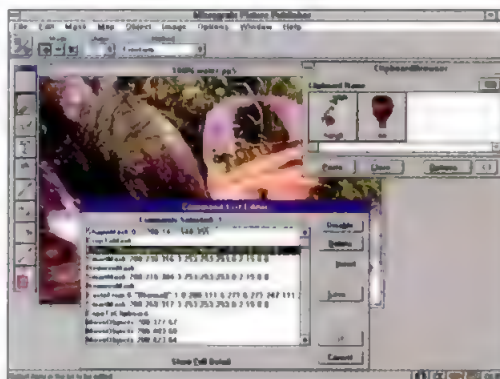
SILHOUETTE: Picture Publisher's Chroma Mask, combined with the Remove Holes command, masks off the flowers in this image.

macro to create a Chroma Mask, manually tweak it with the image mask, change the background fill, and add brushstrokes around the central image; we then played the macro back on a 200-ppi version of the image with excellent results.

While it opens up some intriguing possibilities, the Command List concept falls short of perfection. There's no easy way to automatically discard undesired groups of operations from the Command List or to collapse the stack. Nor does the program handle slider-based functions very well. For the low-resolution processing of a high-resolution image to work, you need to create your macro on an image with

curves (you can use Beziers to edit curves in mapping dialogs), and you can now import Adobe Illustrator EPS paths as masks. The latter capability isn't documented or implemented as well as it should be, however. The Load Shapes command is only available from the right mouse-button menu when the Freeform mask or Edit Points modes are selected, a fact that isn't noted in either the printed or on-line documentation. We also experienced problems getting EPS files to import properly. Another substantive improvement includes better object handling, which is now available with one click of the right-button menus.

While some interface changes are obvious (such as the



CHANGE: Using the Command List takes some practice, but the ability to edit and reorder transformations is a valuable tool.



From October 31 to November 4, you can go on-line to discuss Picture Publisher with Micrografx product manager Craig Simmons. Type GO EXEC at any CompuServe prompt.

ability to create custom floating palettes of tools, commands, and macros), others are more subtle. These include larger preview thumbnails in some of the dialog boxes, less distracting monochrome icons for working on gray-scale images, the ability to escape out of most operations, and improved support for Kodak Photo CD.

Picture Publisher ships with the Kodak Color Management System. The Kodak system includes profiles for a limited number of output devices, and most of them high-end at that. More useful is the addition of a system for visually matching printed output with screen display—a less high-tech but easier to control method for the low-end user.

An interactive tutorial and an on-line help section targeted specifically at Adobe Photoshop users make it easier than ever for new users to learn how to use the product. Performance is similar to the previous version of Picture Publisher (at least, it was on our 486DX2/66 PC with 28MB RAM and an ATI Graphics Pro Turbo video card).

Picture Publisher 5 is a must upgrade for present users. Current Photoshop users may find some of this powerful image-editing package's capabilities tempting as well.

► Micrografx Picture Publisher, Version 5.0.

List price: \$595; upgrade, \$99. Requires: 4MB RAM (8MB or more recommended), 6MB hard disk space (15MB for full installation), Microsoft Windows 3.1 or later. CD-ROM required for clip art and on-line tutorial. Micrografx Inc., Richardson, Texas; 800-733-3729, 214-234-1769.

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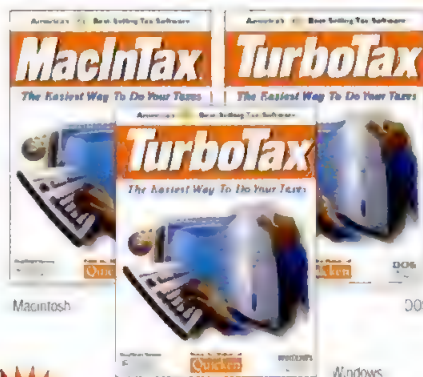
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Spreadsheet Add-Ins

Visualize Data with ChartXL

BY CRAIG STINSON

If the charting engine in your spreadsheet program doesn't meet your needs, you might want to check out Software Publishing Corp.'s Harvard ChartXL. This \$149 program is targeted at the spreadsheet user who needs either a more sophisticated set of chart-customizing tools, or chart types that aren't standard spreadsheet fare.

ChartXL helps people visualize data by offering a gallery of 183 preformatted charts aimed at three broad categories: business, statistical, and technical. For the business user, the program supplies bubble charts, Gantt charts, candlesticks, spiders, and group maps, along with the garden-variety pie charts, bars, lines, and columns. Statistical presentations are served by box-whisker charts, error-bar plots, histograms, Pareto charts, linked scatter plots, and star plots. Technical offerings include surface plots, contour plots, parametric surface plots, polar plots, Smith charts, spectral plots, trajectory plots, vector plots, and a variety of x-y charts.

ChartXL comes with a full set of options that translates into nearly unlimited customization.

You can change the perspective and rotation of any 3-D chart, use drawing tools in order to annotate charts, or embed images or other objects from OLE-server sources. With many of the chart types you can also apply color mapping, so that data points falling within specified ranges are drawn in contrasting colors. You can

zoom to crop or magnify a portion of a chart (on-screen only, unfortunately); and by reducing a chart's size, you can easily create two or more charts on a page.

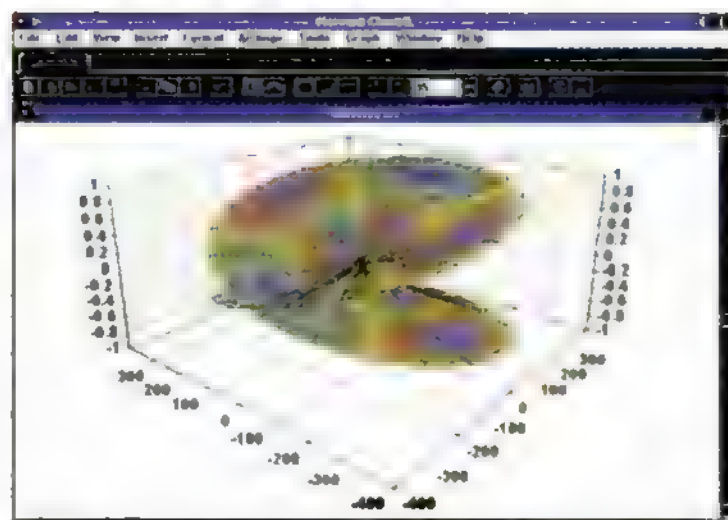
ChartXL includes its own spreadsheet component, which can import data from the expected sources (ASCII, .DIF, .WK1, .WK3, or the Excel 4 .XLS file format), and forge dynamic links with such external files. It'll also paste-link data originating in any DDE-server application. The program's inability to read the native file formats of Excel 5 and Lotus 1-2-3, Release 5, is a frustrating limitation, but you can

paste data via the Clipboard. SPC has promised to support .WK4 and Excel 5 in the next release.

If you can live with these limitations, you will find that there's a lot to like in ChartXL. The graphs are gorgeous, and the extensive gallery will let you present your data in ways

that are simply not possible in any spreadsheet program.

► **Harvard ChartXL.** List price: \$149; competitive upgrade \$99. Requires: 4MB RAM (8MB recommended), 5MB hard disk space (14MB for full installa-



SHOW: ChartXL's ability to present data in interesting and informative ways gives the spreadsheet user more flexibility.

tion), Microsoft Windows 3.1 or later; math coprocessor recommended. Software Publishing Corp., Santa Clara, California; 800-234-2500, 408-986-8000; fax, 408-980-0729.

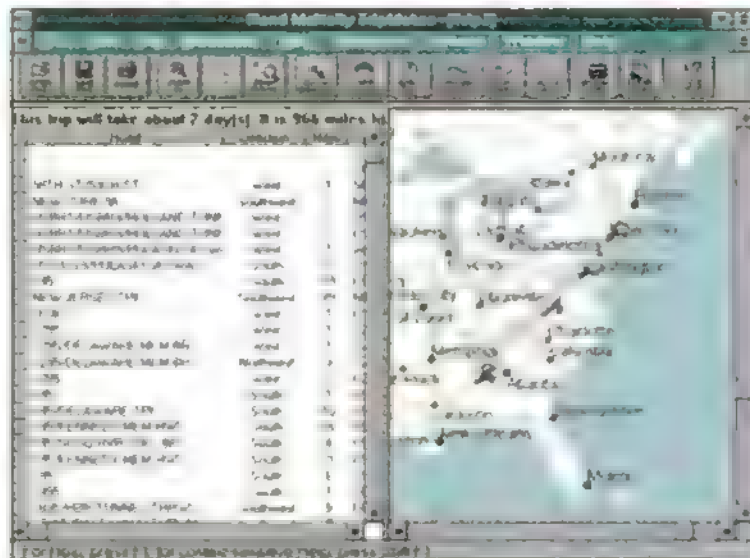
Circle 402 on reader service card.

Mapping

TripMaker Puts Your Route on Paper

BY DAVID HASKIN

Rand McNally TripMaker makes the often time-consuming task of planning road trips remarkably simple. By combining a well designed interface with excellent mapping precision, the \$79.95 TripMaker is aimed both at business travelers and vacationing families.



PLAN: TripMaker shows your printed itinerary and the route map in side-by-side windows.

TripMaker lets you choose a beginning and end point for your journey, as well as stopovers in between. Then, the program determines the route and displays a marked map with an itinerary. TripMaker's Trip Guide dis-

plays dialog boxes into which you add your itinerary, your travel dates, your preferred daily driving time, and whether you want the shortest, fastest, or most scenic route.

Using travel dates and your preference for daily driving time lets TripMaker create a precise written itinerary. One short-

coming, though, is that TripMaker stops you each day after the number of driving hours you specified, even if that happens to be in the middle of nowhere. Also, TripMaker can't include in its calculations how long you will stay at stopovers. Both omissions make it difficult to stick to TripMaker's itinerary. The quick fix is to manually drag the icon indicating a stopover to a more suitable location on the map. TripMaker then automatically recalculates your trip.

TripMaker's routing skills

are unusually precise. It was smart enough, for example, to use a ferry to calculate the shortest route but knew that using a ferry, while shorter distance-wise, often takes longer.

TripMaker often provides only the highway number of state highways in cities, not the street name—a potentially confusing oversight. And don't expect the digital equivalent of the Michelin guide, because unlike its competitors, TripMaker only provides toll-free numbers for hotel chains.

Still, in the suddenly crowded trip-planning software market, TripMaker stands out. That's because Rand McNally built on its vast experience with paper maps by making the software simple enough for families planning their next vacation and precise enough for business travelers.

► **Rand McNally TripMaker.** List price: \$79.95. Requires: 4MB RAM, 11MB hard disk space, Microsoft Windows 3.1 or later. Rand McNally New Media, Skokie, Illinois. 800-671-5006, ext. 110, 708-329-8100; fax, 708-674-4496.

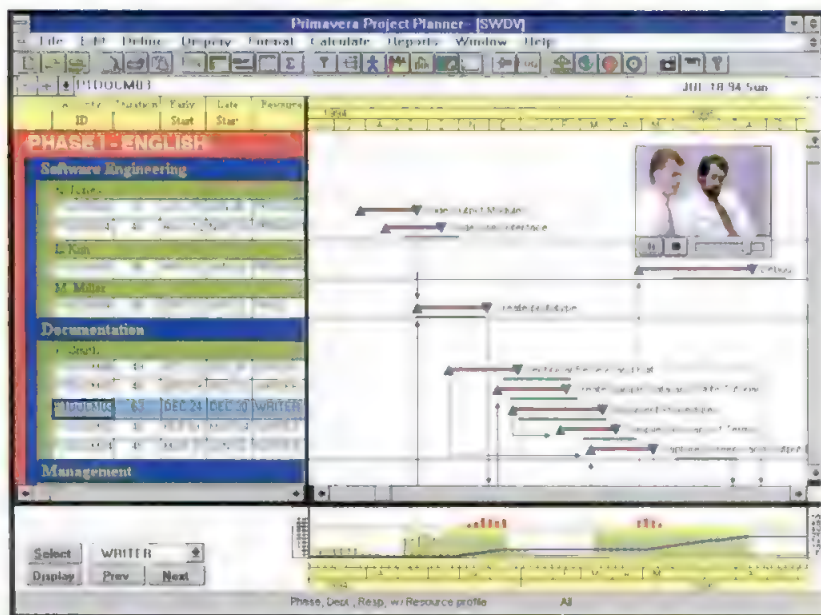
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FIRST LOOKS PLUS

From November 7 through 11, you can go on-line to discuss Harvard ChartXL with product manager Amit Mazumdar and reviewer Craig Stinson. Type GO EXEC at any CompuServe prompt.

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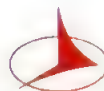
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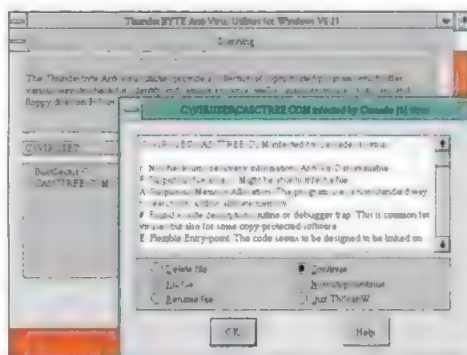
BY NEIL RUBENKING

There is no escaping the fact that modern computer viruses have become devious. The most troublesome encrypt their own code and mutate as they reproduce to avoid leaving telltale digital signatures. The \$80 ThunderBYTE Anti-Virus (TBAV) Utilities for DOS/Windows specializes in rapidly identifying, preventing, and removing viruses, from the simplest to the most insidious.

The first line of defense is testing for changes to executable files. In each directory, the TbSetup module creates a file called ANTI-VIR.DAT, which contains validation and recovery data. TBAV attempts to distinguish valid file modifications, such as storing configuration data, from virus infections. When the TbScan module finds that a file has changed or includes a virus signature—a known digital sequence that identifies a virus—it sounds an alarm. In addition, it actually disassembles portions of the program and simulates running them, looking for suspicious virus-like code, and forcing the virus to decrypt itself.

What qualifies as suspicious code? Based on analysis of the latest computer viruses, direct disk access bypassing DOS is an obvious example, but code that searches for .COM and .EXE files or loops back to its starting point is also suspect. Often a legitimate program will raise one of the 20 major and 8 minor alarms, but a virus will normally trigger several. TBAV will also detect Trojan horses—nonreproducing malicious programs—and joke programs that imitate virus activity.

The TbScan module scans memory, boot sectors, and files for viruses. From the DOS command line, it is extremely



SCAN: ThunderBYTE doesn't have to know which virus has infected a file to detect suspicious activity in the code.

fast; the Windows version is slower, though just as thorough. The memory-resident TbScanx program scans every file you execute, copy, modify, decompress, or download. We decompressed a .ZIP file containing a dozen infected files and TBAV caught every one of them, even a data file contain-

ing a copy of a Michelangelo-infested boot sector.

The TbClean module removes viruses from an infected file when possible. TbClean is meant to be used only after rebooting from a clean write-

protected floppy disk, and tries to restore the file using data from ANTI-VIR.DAT. If that doesn't succeed, ThunderBYTE goes to the source and uses heuristic methods to make the virus clean itself up. TbClean works by disassembling the virus code and simulating its execution in order to

determine just how to restore the original program. There is a downside, though: While the heuristically cleaned program will be virus-free, it may not be identical to the original, so it's always best to restore from backup as soon as possible.

The TbUtil module will save and restore disk boot sectors,

CMOS data, and partition tables. It can optionally immunize a disk by replacing the normal partition table with a modified version that includes a self-test for tampering. Other modules detect virus-like activity such as attempts to remain RAM-resident or format the disk.

The Windows interface for TBAV is rough—clearly a first-time effort. Standard Windows components are used in non-standard ways, so it will take some adjustment to use TBAV to its fullest. However, the underlying DOS utilities are fast and unobtrusive, and in the event of an actual infection, a DOS-based defense system is the best way back to virus-free computing.

► **ThunderBYTE Anti-Virus Utilities for DOS/Windows, Version 6.24.** List price: \$80. Requires: 1MB RAM, 1MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.1 or later. ThunderBYTE North America Corp., Massena, New York; 800-667-8228, 613-930-4444; fax, 613-936-8429.

Circle 427 on reader service card.

■ DOS Utilities

Dial PC911 for Emergencies

BY J.W. OLSEN

You recently upgraded your system and something went seriously awry. CyberMedia hopes the number you remember is 911—as in PC911, their \$79.95 DOS emergency assistance utility.

PC911 creates an emergency boot disk by analyzing your system each time it is turned on. If changes in critical files or peripherals are encountered, the emergency disk is updated. Included on this disk are CMOS settings, critical system files, PC911 itself, UNFORMAT.COM, and more. If applica-

ble, compressed-drive data is also saved.

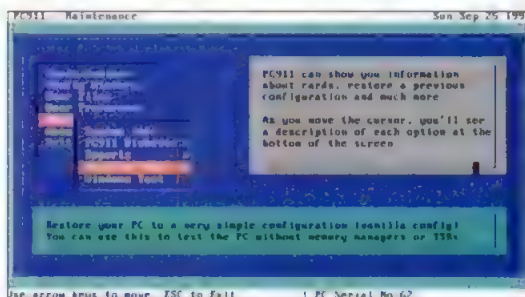
PC911 analyzes add-in devices that use the system's DMA and IRQ resources and records conflicts. This eases the installation of peripherals. Unfortunately, PC911's investigations often err. During our testing, it identified a 486SX sys-

tem with one parallel port as a Pentium PC with three parallel ports. On a second system, an internal fax modem was misidentified as an unused, third serial port. Worse yet, on one system, PC911 couldn't execute SYS.COM, making its emergency boot disk worthless.

Less technical-minded users could benefit from the crisis management and intervention that PC911 affords, but be warned: PC911 may not be the PC paramedic you'll need.

► **PC911, Version 1.0.** List price: \$29.95 until December 31, 1994; \$79.95 thereafter. Requires: 640K RAM, DOS 4.0 or later. CyberMedia, Los Angeles, California; 800-529-2373, 310-843-0800; fax, 310-843-0120.

Circle 426 on reader service card



EMERGENCY ROOM: Call PC911 to examine your system and diagnose problems.

Graphics

Go with the Flow Diagrams

BY ANGELA GUNN

EasyFlow for Windows is the Windows version of a DOS favorite that comes late to a market full of multipurpose charting and diagramming programs. HavenTree Software, the developers of EasyFlow, didn't make the package as comprehensive as products such as CorelFLOW and ABC FlowCharter, but if you seek simplicity and ease of use—nothing more, nothing less—this \$199 package has potential.

First and foremost, EasyFlow is simple to learn and use. Even a first-time user of the program can quickly produce impressive-looking diagrams and charts, including flowcharts, organizational charts, audit diagrams, networking schematics,

and even fault analyses. The program includes comprehensive shape libraries, which conform to the charting conventions of most major accounting firms, and such major users as AT&T. There's flexibility in the multiple-level undo and nameable layers, as well as in the excellent line, shape, and text roll-up windows.

The way EasyFlow handles lines and text stands out. SmartLines, which automatically maps your connecting lines to avoid overlap and confusion, will aid in the building of complicated diagrams. The software's automatic text-flow feature accurately and reliably fits the type to an element's shape. When you move a

shape, both text and connecting lines travel with it.

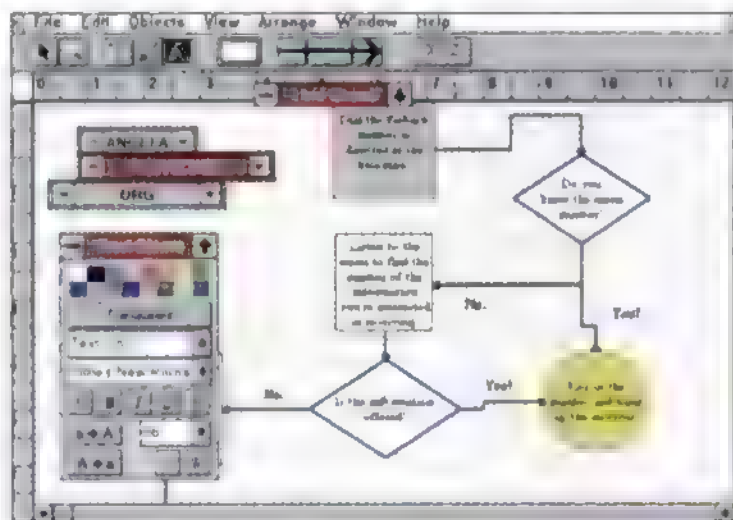
What EasyFlow doesn't have are some of the expected extras that are common to other diagramming packages. The most annoying aspect of the program is the fixed nature of its shape libraries. With EasyFlow you can

ers to show added detail make the package suitable for presentations, but support for more colors would be even better.

It is debatable whether most users will miss the versatility and extra features present in CorelFLOW or ABC FlowCharter. But those who seek an idiot-proof package—particularly users who need support for the many specialized shape libraries and who don't want to customize their own shapes—should take a look at EasyFlow for Windows.

► **EasyFlow for Windows.** List price: \$299; introductory price, \$199. Requires: 4MB RAM, 3MB hard disk space, Microsoft Windows 3.1 or later. HavenTree Software Ltd., Kingston, Ontario, Canada; 800-267-0668, 613-544-6035; fax, 613-544-9632.

Circle 436 on reader service card.



UP TO DATE: EasyFlow's interface keeps you informed about which fonts and line widths you're using.

create new shapes, but you can't save them to a library. The decision to support only 8-bit color is also inexplicable; drill-down lay-

automate the standard menu options, such as File Find or Print, that are found in most applications. You can create buttons that activate any menu items in your applications simply by clicking on the item. You can also assign a macro or a complex DDE command to a button for more involved tasks.

The product's toolbars—called toolpads by Softblox—can float on-screen or attach themselves to the top or side of application windows. We found,

however, that some applications with fixed-size windows will allow only a floating pad. Once you create a toolpad, you set options that let you modify it on the fly by dragging files directly to the pad from File Manager, by moving icons on the pad, or by creating macros. These options can be annoying, though, since the pad sometimes thinks you want to move a button when you really want

to activate the function. After some experimentation with customization, the options will come under control.

The Developer's Edition contains the reference for SmartPad's scripting language, plus a development environment complete with debugger. The scripting language lets you create buttons that modify .INI files, manage the clipboard or SQL tables, and use variables. Although beginners can use a few of these features, the Developer's Edition is designed for experienced programmers.

All told, SmartPad provides the tools to build as many toolbars as you can imagine.

► **SmartPad Standard Edition 3.0.** List price: \$95; Developer's Edition, \$179. Requires: 4MB RAM; 3MB hard disk space (Standard Edition), 5MB hard disk space (Developer's Edition); Microsoft Windows 3.1 or later. Softblox Inc., Atlanta, Georgia; 800-434-0202, 404-892-0202; fax, 404-892-0981.

Circle 435 on reader service card.

Windows Utilities

Build Advanced Windows Toolbars with SmartPad

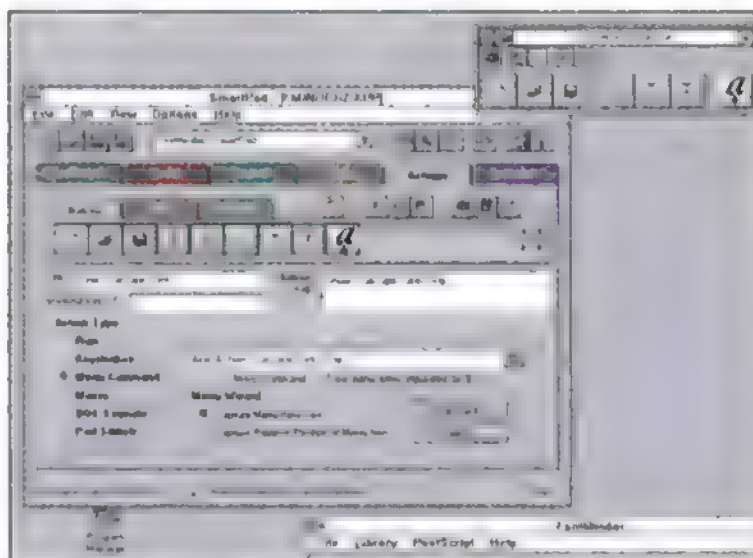
BY EDWARD MENDELSON

Softblox's \$95 SmartPad is an innovative program that lets you build an infinite variety of toolbars that can control just about any aspect of the Windows environment. If you're so inclined, you can even create a toolbar that replaces the Windows Program Manager. A \$179 Developer's Edition includes an elaborate scripting language that adds to SmartPad's usefulness, flexibility, and functionality.

Now in Version 3.0, SmartPad is more automated and more customizable than before. It is also a step ahead of similar functions included with automation packages such as The Norton Desktop

for Windows, PC Tools for Windows. With SmartPad, you can create toolbars that use tabs to switch among specialized toolbars. Icon buttons can use icons, text, or both, complete with balloon help and pull-down menus.

The program comes with an array of preset buttons that



FLOATING PADS: SmartPad's toolbars have icons that can access a macro recorder, a run line, and other features.

Groupware

Collabra Share Provides the Basis for Discussions

BY DAVID DEJEAN

Collabra Share is a groupware product aimed at a new, intriguing, and—as yet—poorly defined niche. It's a network-based forum manager whose goal is to promote discussions within an organization. While Share, which works off of and enhances a company's electronic mail system, overlaps some of the functions of Lotus Notes, its approach is much more focused. What Share does well is to help spur lively electronic discussions within a company.

Share is the first product from Collabra Software, which has obviously done its homework on groupware. It's easy to agree with Share's basic premise: E-mail isn't enough to stimulate discussions within workgroups. Share attempts to leverage a firm's investment in an e-mail network by providing an infrastructure for discussions and the ability to keep track of discussion threads.

E-MAIL PLUS

The product's clean, Windows-based interface makes clear what e-mail has been lacking. Share presents the structure of a forum as a collapsible outline and gives the user a good set of tools for working with large volumes of messages in multiple forums. Its full-text search functions are strong. Share can quickly guide you to unread messages in all forums, and it lets you mark

documents read or unread.

Document-creation capabilities are merely adequate: The program's text formatting rests on the Windows toolbox. Share provides some graphics file format translations, permits attached files, and supports OLE 1 and OLE 2 embedded objects, allowing messages to contain graphs and even video clips.

Other notables in the group discussion market include CompuServe's forums, GENIE's roundtables, BBS discussions, and the Internet's newsgroups. Each of these virtual conversation products is based on remote communications, however, while Share concentrates on the network level. What Share

books, are beyond the scope of Share.

For network-connected workgroups, setting up Share is easy. The software is installed on the file server. The program creates a central post office through which all messages flow. Individual users are assigned accounts, and an

administrator can control access and privileges on a forum-by-forum basis. Set up this way, the \$690, ten-user starter pack is a very inexpensive way to deliver groupware to a group.

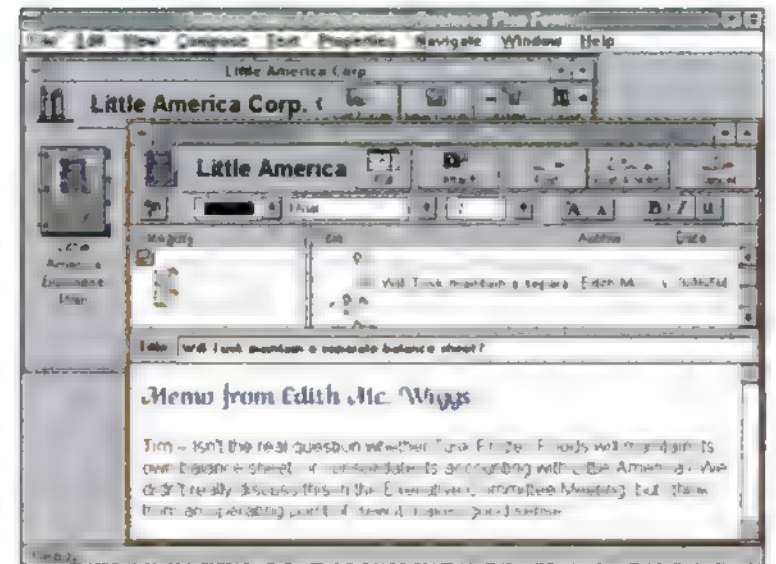
CONNECTION AGENT

By designing in several agents, you can expand Share's scope beyond a single LAN. The \$899 Enterprise Extensions package includes a Mail Agent that—running in conjunction with VIM- or MAPI-based e-mail systems—can connect far-flung members of a workgroup on forums even if they don't all have Share installed. The agent mails new documents to them and adds their e-mail messages to the proper forum; however, they lose the considerable benefits of Share's interface for discussion threads.

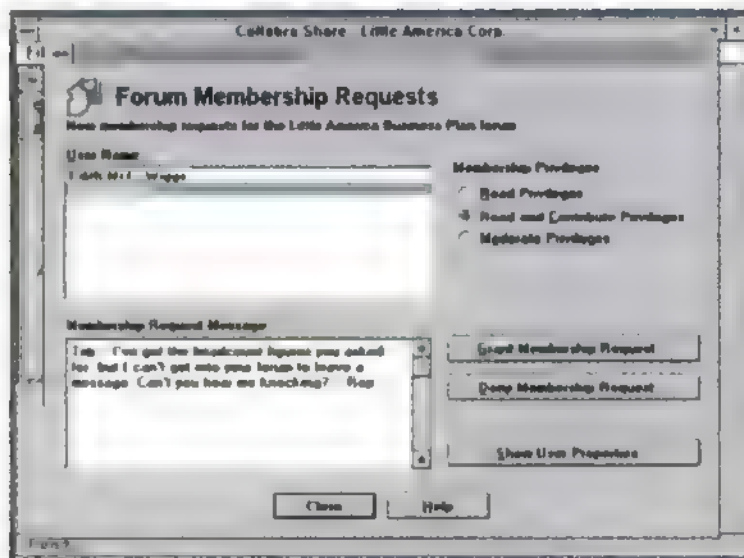
Another agent lets e-mail users send messages that search the forum and send back documents. The Enterprise Extensions also make it possible to replicate forum databases from LAN to LAN using the company's e-mail system.

Two other agents that will add to Share's functionality are promised by Collabra early next

year. One will give Share users access to Internet newsgroups; the other will connect Share forums to Lotus Notes databases. Unfortunately, the Notes connection will be essentially one-way—from Share to Notes—because Notes forms can be too complex to be dis-



BACK AND FORTH: A collapsible outline lets you read messages while seeing where they fit into the overall discussion.



START: The first step in setting up a Share discussion is to establish rights within the forum.

lacks is a Macintosh client version—a necessary element for today's heterogeneous networks. According to Collabra, a Macintosh version of the Share software will be ready in early 1995.

In several areas, however, Share's approach is overly simplistic. It's impossible to edit a message once it has been added to a forum, and information-sharing applications that require reediting and sorting documents, such as name-and-address

played well as Share messages. While one-way communication is a start, two-way communication into and out of Notes is required for Share to work well with Notes.

Comparing Share with Notes shows the potential synergy between the two. Much of what Share lacks is contained in Notes, such as Notes' robust database architecture. This is what you would expect; Share sells for \$69 a seat—a fraction of Notes' \$495-per-user list price.

But to keep the price low, Collabra kept the focus tight and the features to a minimum. Competition from Lotus's new \$99 Notes Express product could make even a bargain-priced forum manager look like no bargain.

► **Collabra Share.** List price: \$69.00 per user for 10-user license; Enterprise Extensions, \$899 per server. Site licenses available. Requires: 4MB RAM, 12MB hard disk space, Microsoft Windows 3.1 or later. Collabra Software Inc., Mountain View, California; 800-474-7427, 415-940-6400; fax, 415-940-6440.

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*All He Does
Anymore Is Tie Me
Up In The
Backyard...*





You see... it's like this Doc... Gateway 2000[®] is man's new best friend. I used to think I was top dog.

I was so much happier before his Gateway 2000 P5-90XL became a bone of contention between us. Walks, roughhousing — we even watched the late show together. Now his biggest passion is his Gateway P5-90XL. The cur.

It's not like I haven't tried. But, I guess I've been barking up the wrong tree, because no matter how much I try to impress him, his Gateway PC makes him happier and happier every day! And although I'm a mere canine, I know the Gateway P5-90XL is a powerhouse. I've heard about its phenomenal features, especially the Microsoft Office Professional applications — MS[®] Excel, Access[®] database, PowerPoint[®] presentation graphics program, Word and Bookshelf[®] '94. That's everything he needs even for his demanding work.

He's a veterinary scientist, so he loves to number crunch, create databases, write reports and integrate his findings into presentations. Sometimes I think he'll chase his tail when he talks about the power of the Intel[®] Pentium[™] processor and how fast he calculates the cases of feline viral rhinotracheitis in purebred Siamese cats in the Pacific Northwest using Excel. Plus, the P5-90XL's 16MB of RAM and a whopping 1GB hard drive give him tons of room for his Access database on diseases afflicting short-haired cats in the twentieth century. (I say let the cats die!)

With his P5-90XL he can even run multiple applications simultaneously. He drools about the Object Linking and Embedding (OLE) feature that automatically updates information in an application after he changes it in a different program. And he pulls up feline anatomy images on his 17-inch CrystalScan[®] monitor in seconds with the lightning-fast speed of the ATI Mach 64 video card. This PC is perfect for him.

When he wants to relax he listens to his favorite music CDs on his Gateway PC. The Ensoniq[®] Soundscape wavetable sound card delivers unbeatable audio quality, and Altec Lansing ACS-31 speakers pump out great highs and heart-pounding bass.

He also goes on and on about Gateway's award-winning service and support and their friendly Midwestern employees. The company's three-year warranty on parts for desktop systems and Gateway monitors is incredible. That's 21 dog years! Gateway customers also get a 30-day money-back guarantee and toll-free technical support. On-site service is available during the first year in most U.S. locations and may be provided without charge if their technicians determine it's necessary. These factors are vital when purchasing a PC in today's dog-eat-dog computer industry.

What's that, Doc? How can you get more information on Gateway PCs and their service and support policies? Geez! Even my own psychiatrist is hounding me. Call or write them and they'll send you a free written copy of their warranty.



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Yes, Dr. Nine, the power of Gateway's Pentium®-based PCs has been unleashed! It's an epidemic that's spreading from one member of my family to another. Now *she* even has a Pentium-based system from Gateway. I can see why Dataquest,® Inc. reported that Gateway 2000® is the leading supplier of Pentium PCs in the nation — they're everywhere!

She's a freelance writer, and ever since she got her P5-90 Best Buy from Gateway 2000 all she does is rave about its amazing features that increase her productivity — like its 540MB hard drive, 8MB of RAM and a super-fast double-speed CD-ROM. I have to admit, she pumps out tons of work now, and it keeps her out of the doghouse because she never misses a deadline.

She especially digs Microsoft® Bookshelf® 1994 that's part of MS Office Professional. It makes research a snap! Bookshelf includes seven best-selling reference books including *The American Heritage Dictionary*, *The Original Roget's Thesaurus*, *The Columbia Dictionary of Quotations*, *The Concise Columbia Encyclopedia*, *Hammond Intermediate World Atlas*, *The People's Chronology*, and *The World Almanac® and Book of Facts 1994*.

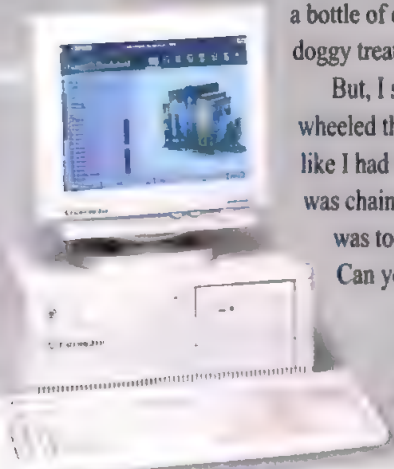
Of course, MS Word, the most popular word processor for Windows, has cool features like spelling and grammar check (she can spell check in 20 languages!), thesaurus and word count. She can even use Word and Bookshelf simultaneously!

Scheduling has never been easier with MS Schedule+® for Windows.™ It helps manage her time, and she can see her schedule at a glance. The PCI local bus graphics and 15-inch CrystanScan® monitor give her an incredible display. It's simply mesmerizing how much her Pentium-based PC has changed her life. Plus it was a great deal at \$2,499!

I'm glad she loves her Gateway PC and all of its awesome software, but now *she's* ignoring me too! She's so engrossed with her P5-90 Best Buy she hardly stops to eat.

One day I prepared her a lunch fit for a queen. An elaborate feast really — Belgian endive salad, savory herbed croissants, wild rice pilaf, grilled apricot-ginger chicken breasts, and white chocolate cheesecake with luscious strawberry glaze. I threw in a bottle of chilled champagne and a few of my favorite doggy treats.

But, I struck out again. She didn't bat an eye when I wheeled the feast into her office. I was stunned — I felt like I had been hit with a newspaper! How could she? I was chained to a hot stove all day. But as usual, she was too wrapped up in her Gateway PC to notice me. Can you believe it, Doc?



"You've got a friend in the business."®

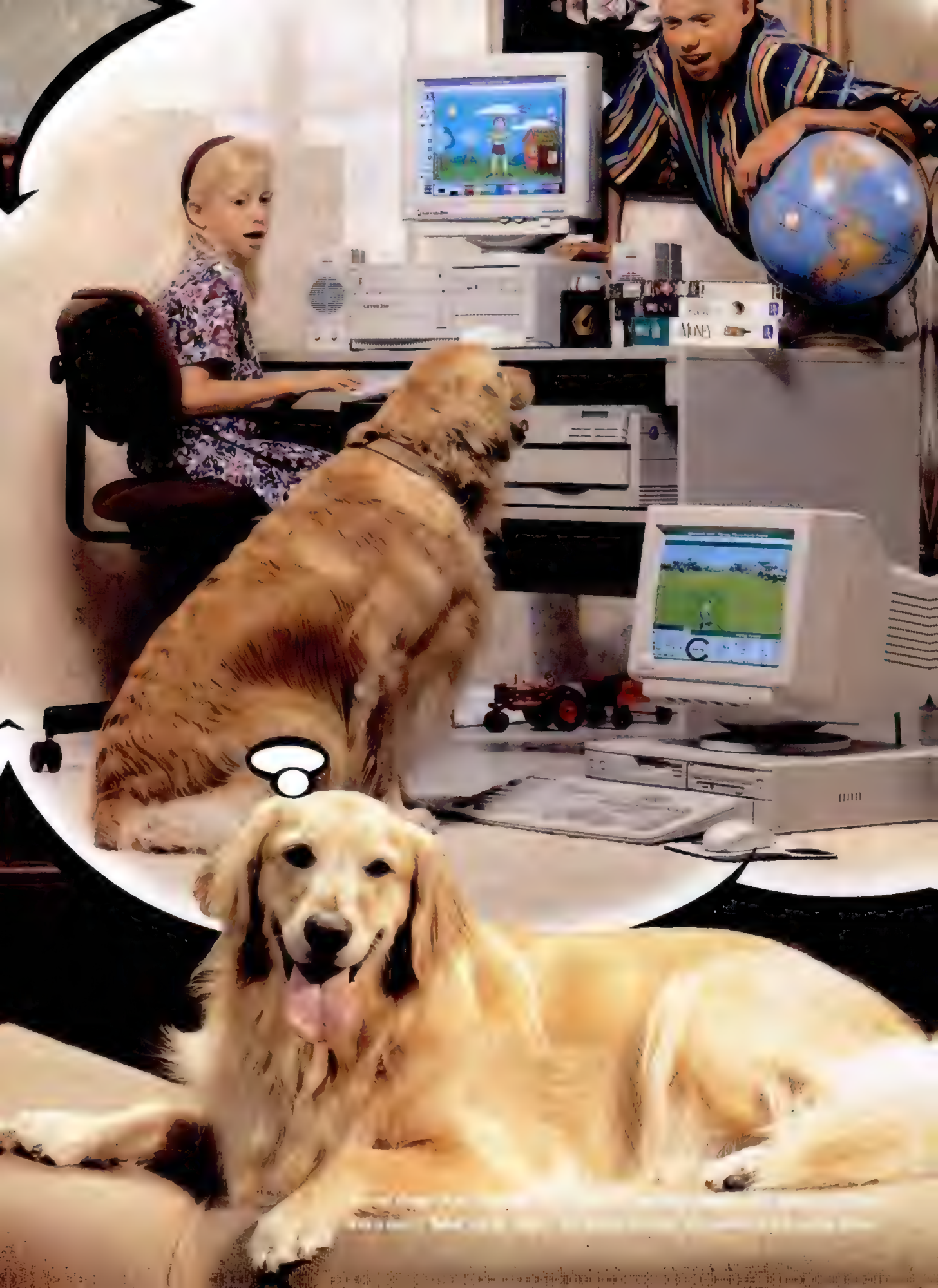
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pentium
PROCESSOR







Doc! I have the solution. I'll get my paws on a Gateway 2000 PC too!

Why was I such a bonehead? Now I'll be part of the family again.

I'll get a 4DX2-66 Family PC™ — a doggone good value at only \$1,899. The kids already have a P5-60 Family PC. I've seen how quickly they can finish their homework with the power of a Pentium-based system. They write reports in no time flat when they use Microsoft® Works® word processor with spell check and thesaurus, along with unlimited resource information from MS Encarta 1994 Multimedia Encyclopedia. And, when they finish their homework early, they can explore the magic behind the movies with MS Cinemania '94, plus exciting software applications designed just for kids.

Now this new world of education and excitement can be mine too. I'll use Encarta to research my pedigree, and I'll plan for my retirement with MS Money™ — the kids have already formulated their college savings funds with this practical application.

I can even kick back and relax with the wonder of MS Multimedia Golf, and with the Family PC's high-quality sound cards and speakers, I can play music CDs, hear audio clips or record audio — all with stereo sound that delights even my sensitive ears.

I have so many exciting plans! I'll be a "Gateway Groupie" and communicate with other Gateway users on-line with my modem. (If I'm lucky I'll find a mate through an on-line dating service, and we'll have our own litter!)

That's it. I have to get my own Gateway Family PC. Gee, I wonder if they sell PCs to dogs? I know they accept most major credit cards and C.O.D. terms, with net 30-day terms and leasing options available to qualified commercial customers. I can also apply for the Gateway 2000 DuoLine™ MasterCard® Card, issued by Dial National Bank, Des Moines, Iowa. Oh, and I'll be sure to ask about their "90 Days No Payment" Program!

Gateway 2000 customers in Canada and Puerto Rico receive toll-free telephone technical service in both countries (see the back page of this ad for special 800 numbers) along with award-winning technical support and CSA approvals. On-site service is available in some Canadian and Puerto Rican locations, and their international shipping rates are among the most competitive in the industry.

Thanks a lot Dr. Nine. You've been a big help. But I won't have time for my weekly appointment anymore — I'll be busy with my new Gateway 2000 Family PC!

Call Gateway 2000 today and get *your paws* on the best value in the PC industry!

Experience a fetching new world of education and excitement with a P5-60 Family PC!



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- Local Bus Graphics with 1MB
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- Desktop Case
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- MS-DOS 6.22 & WFW 3.11
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- ✦ 3-Year Limited Parts Warranty

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- 3.5" Diskette Drive
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- Desktop Case
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- ✦ Double-Speed CD-ROM
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- 17" Color CrystalScan 1776LE
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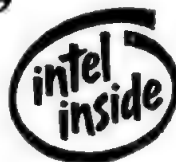
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 - New Altec Lansing ACS-31 three-piece speaker system
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Altec Lansing ACS-31 Speakers

A Gateway exclusive from Altec Lansing: a three-piece speaker set at a two-piece price. Two 3-inch free-standing speakers crank out up to five watts per channel while the subwoofer can deliver 15 watts of heart-pounding bass. **\$99**

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You get nearly \$700 worth of software for less than \$100! Package includes Cinemania '94, Mad Dog McCree, Tuneland, Mayo Clinic Family Health Book, Better Homes and Gardens Cookbook, The Lawnmower Man, Sitting on the Farm, Mavis Beacon Teaches Typing, Chess Master 3000, U.S. Atlas and World Atlas. You also get a compact disc cleaner and 20-disk storage rack. **\$99**

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Non-interlaced color monitor with intelligent multi-scanning analog color display capable of 1280 x 1024 resolution in non-interlaced mode, .26 dot pitch. Upgrade from a 14-inch CrystalScan 1024NI monitor **\$395**
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Internal fax/modem, 14,400bps modem, V.32bis, with 14,400bps fax capability. Includes data and fax communication software, CoSession™ Host remote diagnostics, plus a CompuServe® trial membership. **\$99**

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A full-featured 300dpi printer loaded with enhanced PCL 5 and 26 scalable typefaces with 1MB standard HP Memory Enhancement Technology. Includes parallel cable. **\$699**

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A 600dpi printer for four times the dots of 300dpi laser printing with enhanced PCL 5 and 45 scalable typefaces. 2MB standard memory and 3 universal SIMM slots available for additional memory or PostScript fonts. Includes parallel cable. **\$999**

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- Ethernet adapter. **\$149**
- Token Ring adapter. **\$449**



8 0 0 - 8 4 6 - 2 0 6 3

Integrated Software

WordPerfect Gives Windows the Works

BY DAVID HASKIN

Although integrated programs date to the dawn of the PC age, it took until now for WordPerfect to release a Windows version of WordPerfect Works. This \$109 application suite features solid entry-level modules that are innovatively integrated to simplify the creation of complex documents. In addition to the expected word processing, spreadsheet, and database mod-

The strong spreadsheet module includes 112 functions, but the most impressive part is its charting capabilities. It comes with more than 80 different chart types that you can extensively customize; all charts can be rotated to help in visualizing the data. The flat-file database is less impressive. It supports most spreadsheet functions in calculated fields and includes such basics as customizable forms and the ability to save

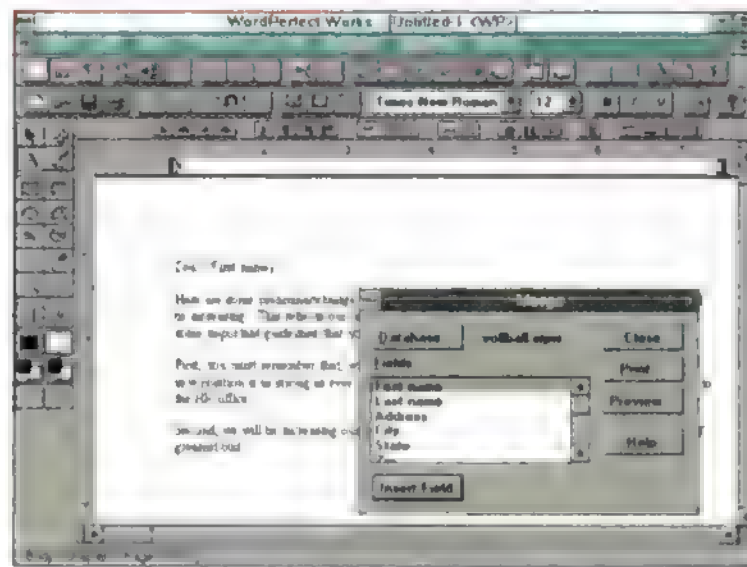
queries. However, its querying capabilities are weak: It supports the Boolean operators AND and OR but doesn't support the NOT operator.

The drawing and paint programs are reasonably customizable, with the ability to edit the contents of the color and fill palettes. They offer no particu-

larly powerful or innovative features, however.

EASY START

WordPerfect has taken a document-centric approach to integrating the disparate elements of Works. On the whole, the way the modules fit together and interact is laudable—at least for creating compound documents. Like the competing ClarisWorks, documents can contain frames that are made up of elements from other modules. For example, to add a spreadsheet frame to a word processing document, you click on a toolbar button and size the frame by dragging your mouse across the document. A worksheet then



COMBINE: WordPerfect Works' mail-merge capabilities are easy to use but not very powerful. You use this dialog box to select a database and the merge fields.

merge function is simple to use but not very powerful. From the mail-merge dialog box, you choose the database and the merge fields. However, you can only merge to the printer, not to a new document.

CONSISTENT LOOK

Ease of use with WordPerfect Works is a mixed

bag. The interface is generally self-evident and consistent between modules, and the package includes parts of WordPerfect's excellent file-management capabilities. As with WordPerfect for Windows, these abilities let you select files and perform standard functions like moving, copying, and deleting the files. Works, however, doesn't have WordPerfect's ability to search for specific filenames or text within files. Nor are there tools (such as Microsoft's Wizards or WordPerfect's own Coaches) to walk users through more complicated tasks. Also, the documentation is unusually slim; Works' 100-page booklet barely covers the basics.

Entry-level integrated programs are not known for their scope. Overall, WordPerfect Works' feature set is about as powerful as those of competing packages. Its document-centric integration makes creating compound documents a breeze. However, its lack of interaction among modules will frustrate more sophisticated users, and newcomers will suffer a bit from its lack of documentation and on-line tutors.

Integration involving the database module is poor. You can't query the database while in another module and insert the query results in the document. This means you can't, for example, query for employees who are due for evaluations and place their names in a memo.

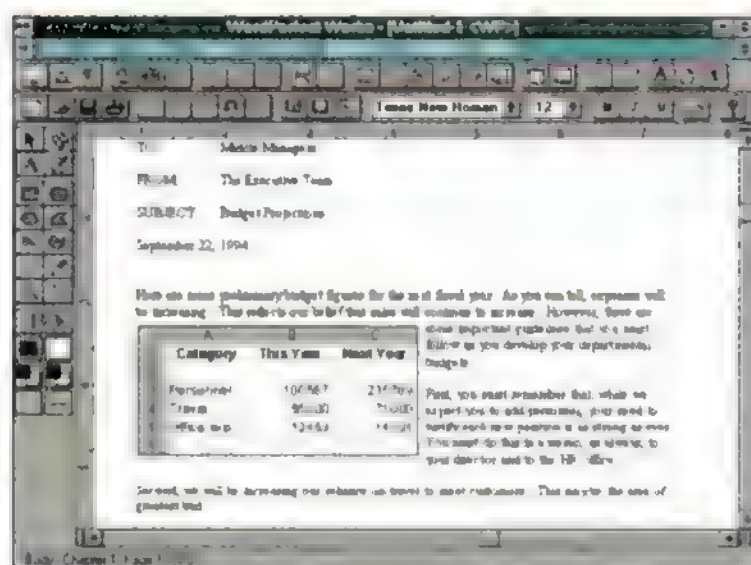
In a related vein, the mail-

appears within the word processing document; when you click on a cell, all of Works' spreadsheet capabilities become available in the menus and toolbar. Similarly, you can mix and match frames for the paint, draw, and word processing modules.

Unlike OLE, this integration scheme does not embed an external file but actually adds the item to the document. Besides being a fast and powerful way to create compound documents, it is also flexible. After adding a spreadsheet frame, for example, you can use the spreadsheet data to add a chart to your document that changes as the spreadsheet changes.

There are limitations to this scheme: Spreadsheets that are too large for word processing documents must be created directly in the spreadsheet module. Then you must copy and paste selected cells from the spreadsheet module into your document. As you change the large spreadsheet, you must manually update your word processing document, a problem that would not occur if Works supported OLE or DDE.

Integration involving the database module is poor. You can't query the database while in another module and insert the query results in the document. This means you can't, for example, query for employees who are due for evaluations and place their names in a memo.



MIX AND MATCH: WordPerfect Works' integration scheme makes it easy to pick and choose from modules. Here, a spreadsheet is located within a word processing document.

ules, Works also includes a drawing program and a paint module. The major missing link, however, is a dedicated communications module.

Not surprisingly, WordPerfect Works' word processing module is its strongest. Among its more sophisticated abilities, you can create columns and change column widths on the fly. You can also create footnotes, footers, headers, annotations, and custom-style templates. While the word processing module includes the same spell-checker and thesaurus found in WordPerfect for Windows, it lacks WordPerfect's Grammatik grammar checker and the ability to create a table of contents and an index.

► **WordPerfect Works 2.0 for Windows.** List price: \$109. Requires: 4MB RAM, 7MB hard disk space, Microsoft Windows 3.1 or later. WordPerfect, the Novell Applications Group, Orem, Utah. 800-451-5151, 801-225-5000.

Circle 420 on reader service card

Video

Diamond's Viper Pro Video: First Graphics Card with DCI

BY JON HILL

With the release of its \$799 Viper Pro Video accelerator card, Diamond Multimedia Systems is the first vendor to provide a video and graphics controller that takes full advantage of the new Display Control Interface (DCI) developed by Intel and Microsoft. This interface makes possible a high-performance graphics card that can play back realistic video in any size window.

The 4MB version of the Viper Pro Video board we tested (using WinBench 4.0 in a 486DX2/66 PC) achieved a Graphics WinMark score of 10.9 million pixels per second at 1,024-by-768 resolution in 32-bit color mode (16.7 million colors), and a score of 13.1 million pixels per second at 1,024-by-768 resolution in 8-bit color mode (256 colors). These scores place the Viper Pro Video firmly in the upper echelon of graphics card performance for this system.

But the Viper Pro Video, which relies on the Weitek P9130 video accelerator chip, goes beyond graphics to play video. The combination of video-acceleration hardware and DCI-compliant drivers allows the board to perform color space conversion, image scaling, and pixel interpolation. What you'll notice is the card's ability to display full-screen video. Nonaccelerated playback of a 320-by-240 resolution, 24-bit video clip on a 486DX2/66 system can slow to 2 frames per second (fps) when the images are displayed at even twice their normal size. In contrast, the Viper Pro Video can stretch the same clip up to four times its normal size, while maintaining its full-frame rate of 30 fps.

Speed is not sacrificed at the expense of playback quality, which was exceptional, especial-

ly when using files compressed with Intel's new Indeo 3.2. The card also works well with a variety of video formats, including M-JPEG, Cinepak, Video-1, and older Indeo 3.1 files.

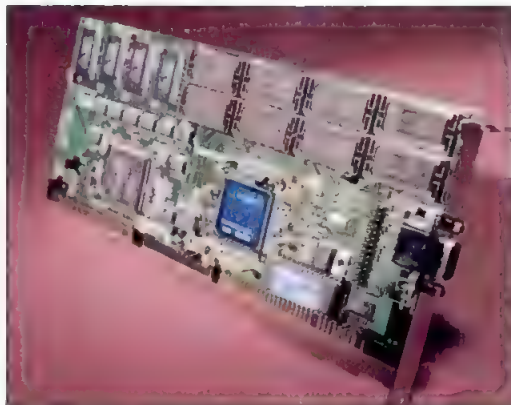
According to Diamond, full-screen MPEG playback will be supported eventually, although the drivers that we reviewed were unable to support M P E G . Although the Viper Pro Video card doesn't offer

special connectivity to standard video input devices, it does include a runtime version of Video for Windows 1.1d, a suite of updated video CODECs, and the DCI drivers.

The Viper Pro Video board provides accelerated playback, but not video capture, for roughly \$50 over the cost of the non-video-enhanced Viper SE card. As an integrated graphics and video product, the Viper Pro Video provides a glimpse of the future of video on the PC.

► **Viper Pro Video.** List price: 4MB version, \$799. Requires: PCI or VLB slot. Diamond Multimedia Systems Inc., Sunnyvale, California; 408-736-2000; fax, 408-730-5750.

Circle 424 on reader service card.



ENLARGE: The Viper Pro Video is the first card that uses DCI to play back full-screen video.

Video

Cable-Ready Computer

BY DANIEL GROTTA AND SALLY WIENER GROTTA

Why would anyone want to use Hauppauge Computer Works' \$349 Win/TV-Cinema board to turn a \$2,500 computer into the equivalent of a \$199 color TV set? The long answer is that the Win/TV-Cinema system provides an easy and inexpensive way to incorporate video or still images from a TV, camcorder, VCR, or any other NTSC broadcast feed. The short answer is that it's fun.

The Win/TV-Cinema system supports 8-bit, 16-bit, and 24-bit color modes; 256 gray scales; and resolutions of up to 1,024 by 768 pixels. Since U.S. broadcast signals are composed of 525 interlaced line scans, the higher resolutions translate into double scanning for higher quality screen captures. The board has built-in hardware to perform 2X zooming, and both its window size and aspect ratio can be customized.

Installing this three-quarter-

length 16-bit ISA board was easy. But be warned: The board should be installed in the slot next to your VGA board because you'll have to link the two with a pair of cables. The back of the board has ports for cable TV feed, audio output, and audio/video input. It took about



PG-TV: Win/TV-Cinema lets you capture and display video.

45 minutes to install the board and attach the cables, plug in the cable TV's coaxial connector, add a pair of mini-speakers, set up a VideoLabs FlexCam video camera next to the computer, and set up the board's software. Another 5 minutes of playing with the Display, Options, and

Configure pull-down menu options, and we were flipping among CNN, HBO, and a picture of ourselves (via the FlexCam camera).

Saving still images is simple: You just click on the camera icon and choose the filename and format (.BMP, .PCX, .MMP, or TIFF). Capturing and displaying video clips is marginally more complicated, and playback is at only 15 frames per second.

There are a few other quirks, though. The board does not have a built-in audio amplifier, so powered speakers or an audio board are required (the sound is mono only). Some cable channels may display poorly, not because of any board flaw, but because of the quality of the broadcast signal. But the biggest problem with the Win/TV-Cinema board is that it works so well it can be addictive.

► **Win/TV-Cinema.** List price: \$349. Requires: 4MB RAM, 1MB hard disk space, Microsoft Windows 3.x. Hauppauge Computer Works Inc., Hauppauge, New York; 800-443-6284, 516-434-1600; fax, 516-434-3198.

Circle 423 on reader service card.

So sophisticated, it's simple

New 5.0

Paradox for Windows - [WorldOptics Order Entry System]

Record Properties Tools Window Help

Customer

Contact Name: Loren Niday
 Telephone: +44-71-123456
 Company Name: The Camera Shop

WORLD OPTICS

Order

Order No.	Date	Total Amount	Status:	Ship via:	Ordered by:	PO No.:
2199	1-Jul-94	2,723.00	☒ In Stock	Two day	Telephone	M1209
2286	12-Jul-94	1,235.23	☐ Back Ordered			
2350	3-Aug-94	1,913.55	☐ Discontinued			

Camera			Filters			Video Camera		
Qty	Unit Price	Total Price	Qty	Unit Price	Total Price	Qty	Unit Price	Total Price
2	1,195.00	2,390.00	2	19.00	38.00	1	1,565.00	1,565.00

Print Invoice Upload Order

WordPerfect [Paradox For Windows - Paradox 5] FILTERS.DOC

File Edit View Table Record Properties Window Help

WORLD OPTICS

Dear Mr. Broan:

We appreciate your giving our valued customers an opportunity to test your new product. Furthermore, we are very pleased that you will ship the filters directly to our customers, thus saving us the shipping and handling.

Here are the names and addresses so that you can fulfill the orders:

CUST	Company Name	Street	City	Postal Code
1	The Camera Shop	123 High Street	London, UK	SW1 1RG
2	Visuals	38, rue du Temple	Paris, France	75004
3	Cavagnan & Company	Rua Antonio 187	Sao Paulo, Brasil	13206

Thank you for your cooperation. We look forward to working with you in the future.

Sincerely,



▲ Paradox for Windows, an integral member of PerfectOffice Professional, has superior integration with suite applications. Thanks to OLE 2.0, you can place any "live" Paradox table directly into a WordPerfect or Word document and edit it in place. (This is not available in Access 2.0.)



February 1994



May 1994



June 1994

◀ With over 20 major industry awards for excellence, Paradox for Windows is the most award-winning database on the market

OK

Why Paradox beats Access

End-user Features	Paradox 5.0	Access 2.0
Built-in computer-based training	✓	
Experts/Wizards to guide you step-by-step	✓	
Integrated graphics	✓	✓
Built-in workgroup and mail capabilities	✓	
Quick Filter without query process	✓	
Power-user/Developer Features		
OLE 2.0 client and server support	✓	
Compatibility with applications from previous version	✓	
Superior network support	✓	
Transparent connectivity and scalability with database aliases	✓	
Record level locking	✓	
Full range of data types including Time, Graphic, and Autoincrement	✓	
Graphical Integrated Development Environment (IDE)	✓	
JDBC-compliant	✓	✓
Dedicated high-performance native SQL drivers	✓	

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Office integration outshines Access

Full client and server support for OLE 2.0 and DDE make Paradox the best database for use with other applications including PerfectOffice and Microsoft Office. For example, you can place a "live" Paradox table in a Word document, edit the table in place, and your changes are automatically updated. (*Access can't do this.*) And Paradox gives you record level locking, that provides enhanced productivity in multiuser environments. (*Access locks up your whole page!*)

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More speed, developer enhancements, and Client/Server connectivity

New Paradox 5.0 for Windows has been tuned to give you better performance. It stores and retrieves data faster, and delivers answers to queries with more speed than ever before.

And Paradox 5.0 for Windows has kept developers in mind too. There's a new Integrated Development Environment and more than 300 new Methods and Properties help you develop ObjectPAL™ for Windows applications faster. Plus, with Borland's new high-performance native SQL links, Paradox is ready when you are to upsize your applications to the Client/Server environment.

Get started fast with Paradox 5.0 for Windows' ease-of-use and you'll quickly discover it's the one database with the depth and performance you want to stay with.

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Borland
The Upsizing Company

PIMs

Day-Timer Organizer: A Face Lift for Instant Recall

BY DON WILLMOTT

The world probably doesn't need another personal information manager, so Day-Timer Technologies hasn't created one of its own. Instead, it has acquired Chronologic Corp.'s Instant Recall for Windows and given it a modified look. The \$139 Day-Timer Organizer is a PIM that will be completely familiar to users of Instant Recall and very easy for newcomers to learn.

Day-Timer Organizer has all the traditional PIM features you'd expect—appointment calendar, to-do list, address book, and scheduler—and they come up on-screen looking as much like the traditional paper Day-Timer as possible. Whether that's a blessing or a curse depends on your viewpoint; Instant Recall users making the switch may resent the screen clutter, but it may help those migrating from the Day-Timer notebook organizer. The screens are somewhat customizable so you can clear away a few of the extraneous icons, but there is a lot happening in every screen.

Day-Timer Organizer has deepened the functionality of just about all of Instant Recall's features. There are now fields for telephone extensions, fields for multiple addresses, and fields that are customizable. A new ExpenseOrganizer helps you track travel expenses as they occur, and improved printing tools get your schedules and lists onto all kinds of paper sizes. In testing, however, we had trouble getting labels to print with the proper alignment.

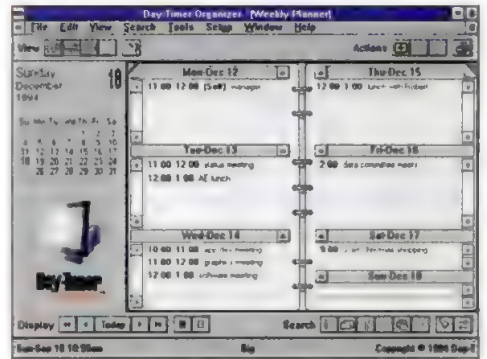
With its new Day-Timer-like screen displays, the program is reminiscent of Lotus Organizer. It stands out, though, with strong group-scheduling features. Day-Timer can let small workgroups share schedules, find optimal

meeting times, and send meeting invitations directly through an existing VIM or MAPI-compliant e-mail system.

If you're a user of a traditional Day-Timer looseleaf, then Day-Timer Organizer makes great sense. If you're an Instant Recall user, you don't necessarily need to upgrade now, but this is the upgrade path that you'll eventually have to follow. If you're just shopping for a new

PIM, Day-Timer Organizer is a middle-of-the-road program that doesn't attempt to reinvent the PIM concept in the way that programs like ECCO Professional, CrossTies, and WordPerfect InfoCentral have.

► **Day-Timer Organizer.** List price: \$139. Requires: 4MB of RAM, 4MB hard disk space, Microsoft Windows 3.1 or later. Day-Timer Technologies, San Mateo, California;



A PIM WITH PAGES: It's no surprise that Day-Timer Organizer's screens mimic paper-based daily planners.

800-859-6954, 415-572-6260; fax, 415-572-9675.

Circle 421 on reader service card

Windows Utilities

FileManager with a Plus

BY J.W. OLSEN

WinWear's \$49.95 (\$29.95 through the end of the year) FileManager+, Version 2.0,—a newcomer to the Windows utility market despite its version number—is one of those products that doesn't offer novel functionality, yet should still quickly win converts.

If you avoid Windows' File Manager because of its limitations or want some instant additional power, FileManager+ warrants a close look because it augments File Manager with a great combination of well-organized, readily-accessible features. You'll discover productivity gains without the need to learn a whole new way of working with your PC.

FileManager+ offers a number of functions not provided by Windows, including basic file trash can and product installation capabilities, as well as PKZIP-compatible compression and decompression of files. A disk-cleaning feature searches for and optionally deletes duplicate files. Encryption and decryption offer any of five levels of security for

files, including government-strength DES and DES III. You can encrypt a file in place of the original or into a vault directory. If you choose the latter, you can optionally compress it or delete the original.

FileManager+ creates a Favorite Applications program group. The real value of this group is made apparent the first time you access the FileManager+ replacement for Windows' Task Manager. The replacement task manager lets you access a Favorite Applications program as easily as any running task. It also sees hidden tasks that the standard Task Manager can't.

A module can place an icon

on your desktop for each logical drive. Right-clicking on an icon performs tasks such as opening a DOS window or invoking File Manager on the drive.

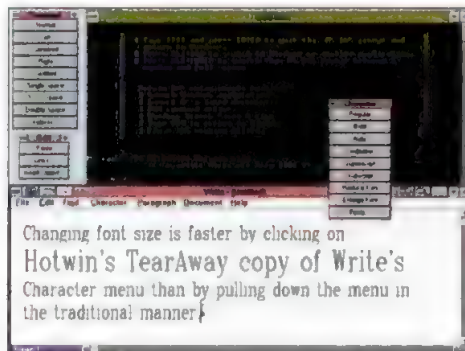
Most FileManager+ applications can be accessed in various ways. You can open them from a new FileManager+ program group, or you can invoke File Manager and click on the new toolbar or the applets' icons, which are loaded with File Manager. Many of the icons also accept drag-and-drop files.

The toolbar can be configured to execute any of 42 tasks. A drop-down dialog box on the toolbar accepts and immediately runs any DOS or Windows command, and retains a history of recent commands that you can click to invoke again.

If you want to overcome the limitations of File Manager without learning a complete replacement environment, FileManager+ may be the utility for you.

► **FileManager+, Version 2.0.** List price: \$49.95 (\$29.95 through December 31, 1994). Requires: 4MB RAM, 1MB hard disk space, Microsoft Windows 3.1 or later. WinWear, Bellevue, Washington; 800-803-9358, 206-635-0856; fax, 206-635-0823.

Circle 422 on reader service card



VERSATILITY PLUS: Configure the FileManager+ toolbar your way, or use its dialog box to run any DOS or Windows command.

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Just don't have the time for power problems on your PC? Don't worry. They'll always make the time for you.

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satisfied APC users won't...**

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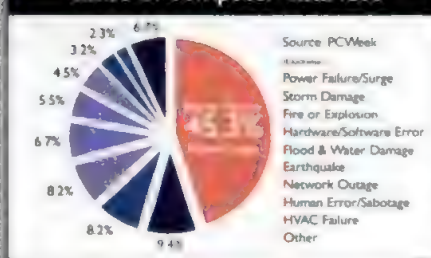
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Audio

Big Sound, Small Boxes

BY BILL HOWARD

With consumer audio sales flat and multimedia PC sales booming, hi-fi companies are beating a path to the PC market and learning along the way. Available through mail-order only, the Cambridge SoundWorks \$199 three-piece speaker system occupies the rarified upper end of the PC speaker market along with offerings from Altec-Lansing, Acoustic Research, and Bose.

SoundWorks produces consistently high quality sound while taking up hardly any desk space.

SoundWorks consists of a single black subwoofer, the size of a shoebox, handling bass sounds from 30 Hz to 150 Hz, and a diminutive pair of 3-by-3-by-3-inch high-frequency speakers that are available in basic black or computer-gray. The subwoofer contains the amplifiers, bass-level control, and all connectors. To adjust overall volume, you use

the controls on your sound board, which can be a minor inconvenience.

The key to its great sound is SoundWorks' bi-amplification: separate amplifiers for the subwoofer and a pair of satellite speakers; even if the subwoofer is played too loudly, the satellites won't be distorted or starved for power. SoundWorks plays loudly and cleanly as a multimedia speaker for room-size presentations, although it won't produce deafening levels in an auditorium.

But for the home or office,



SOUND OFF: The SoundWorks speaker system combines high quality audio with a small footprint.

SoundWorks hits the right note.

► **SoundWorks.** List price: \$199. Cambridge SoundWorks Inc., Newton, Massachusetts; 800-367-4434, 617-332-5936; fax, 617-332-9229.

Circle 430 on reader service card

Internet Front Ends

SPRY Opens up the Internet

BY ANGELA GUNN

No one's saying that the Internet is a piece of cake. But SPRY's Internet In A Box combination of excellent software and helpful books will give you an appetite for getting on-line.

Internet In A Box includes both a subset of Spry's AIR TCP/IP software (a recent Editors' Choice winner; for more information, see *PC Magazine*, October 11, 1994) and a new edition of Ed Krol's step-by-step classic *The Whole Internet User's Guide*.

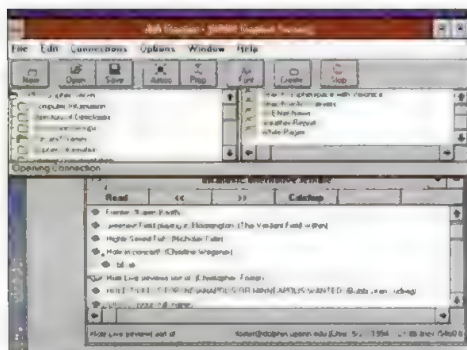
The program's dialer no longer displays the negotiations it undertakes with your server and there is no winsock switcher (which allows networked users to select whether they'll connect

via network or via modem); a simple configuration utility is used instead. Mail, news, Gopher, file transfer protocol, Mosaic, and telnet modules are included, as are ImageView (a graphics viewer) and the UUCODE utility for sending binary files by e-mail.

The package offers access to the Internet via the Global Network Navigator service and the ability to automatically sign up for a PPP SprintLink Internet account through InterServ, although you still have the choice of using your own PPP account. Nothing is left to chance here: Internet In A Box provides a foolproof means of getting yourself on the Internet.

► **Internet In A Box.** List price: \$149. Requires: 4MB RAM, 5MB hard disk space, 9,600-bps or faster modem, Microsoft Windows 3.1 or later. SPRY Inc., Seattle, Washington; 800-777-9638, 206-447-0300; fax, 206-447-9008; Internet, iboxinfo@spry.com.

Circle 428 on reader service card.



GRAZE: Internet In A Box is fodder for the information hungry.

Contact Managers

METZ Phones: Think Small

BY BARRY BRENESAL

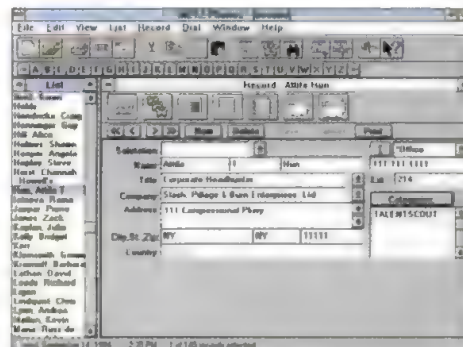
When it comes to contact managers, bigger isn't necessarily better. METZ Phones is an address book and telephone manager that succeeds by thinking small.

While METZ Phones doesn't schedule appointments, has few reporting options, and doesn't have faxing capabilities, it does support databases of unlimited size. Each record can correspond to as many as three addresses, two notepads, and an endless number of user-definable fields.

METZ Phones imports data from information managers in several formats: tab- and comma-separated, Microsoft Cardfile, Lotus 1-2-3, Quattro Pro, Excel, and Symphony. It displays the contents of the first incoming record so you can match each field to its own field structure.

Once you have a database, accessing any record is a snap. METZ Phones maintains a list of contacts along the left side of the screen, sorted by any field.

With its ease of use, speed of access, configurability, and admirably small footprint, METZ



LOCATE: Keep track of valuable contacts with METZ Phones.

Phones comes up a winner.

► **METZ Phones 5.5.** List Price: \$89; upgrade, \$29. Requires: 4MB RAM, 2.5MB hard disk space, Microsoft Windows 3.1 or later. METZ Software Inc., Bellevue, Washington; 800-447-1712, 206-641-4525; fax, 206-644-6026.

Circle 429 on reader service card

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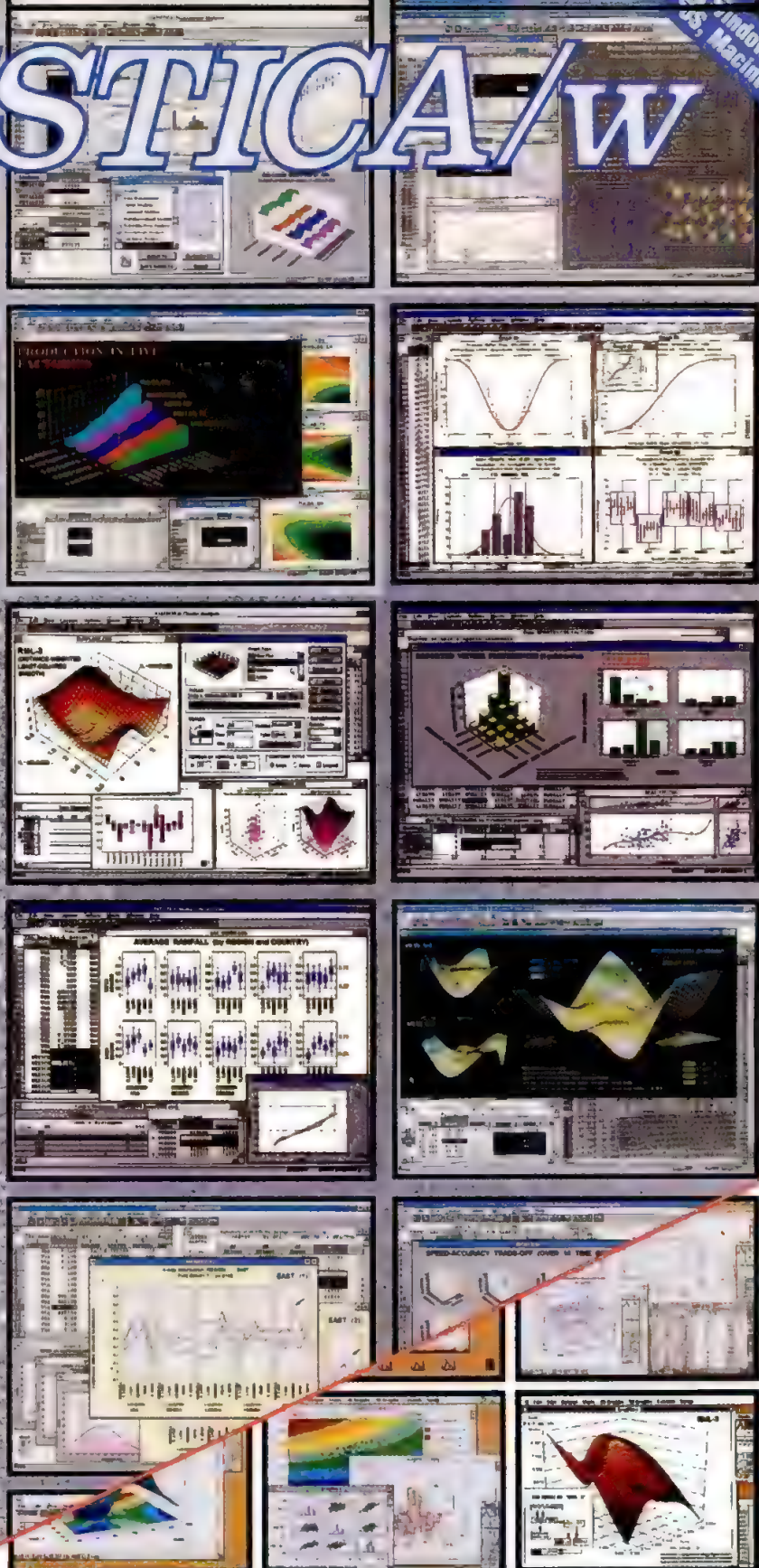


CIRCLE 057 ON READER SERVICE CARD

StatSoft™

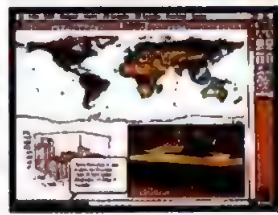
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Overseas Offices: StatSoft of Europe (Hamburg, FRG), ph 040/4200347, fax 040/4911310, StatSoft UK (London, UK), ph 0462/482822, fax 0462/482855 StatSoft France ph (1) 45 66 97 00, fax (1) 45 66 06 51, StatSoft Pacific (Australia), ph (03) 663 6580 fax (03) 663 6117, Available from other Authorized Representatives worldwide Sweden: ph 018-240035, fax 018-210039 Finland: ph 24-334678, fax 24-333867, Belgium: 10 61 16 28, South Africa: 12-663-4500 Japan (Macintosh) ph 03-3770-7600 Japan (Windows) ph 03-3667-1110
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STATISTICA/Mac™ (for Macintosh) A STATISTICA/w-compatible, comprehensive data analysis and graphics system designed for the Macintosh ■ Large selection of statistical methods fully integrated with presentation-quality graphics (incl. EDA, multiplots, a wide selection of interactively rotatable 3D graphs; MacDraw-style tools) ■ Unlimited size of files ■ Full support for System 7, incl. "Publish and Subscribe" ■ Price \$695.

Quick STATISTICA/Mac™ (for Macintosh) A subset of STATISTICA/Mac: a comprehensive selection of basic statistics and the full graphics capabilities of STATISTICA/Mac ■ Price \$395.



Look for us on all the major networks.

Word about PCs from Hewlett-Packard is getting around, and ratings are soaring. According to a recent CRN/Gallup survey, "Use of HP desktops in Fortune 1000 companies has doubled in the last year."¹

And with good reason. Our broad range of PCs not only meets users' expectations for power and ease of use, it also answers the needs of a network manager. With built-in features like on-board networking, advanced security and asset tracking, HP PCs have what it takes to be top performers on virtually any network. And soon our expertise in network management will reach all the way to the desktop, as we continue to pioneer the development of DMI (Desktop Management Interface).

For more information or the name of your nearest HP dealer, call us today at 1-800-322-HPPC, Ext. 8567. And tune in to the network superstars.

Give your other PCs something to look up to.

If you're connecting PCs to a network, scan this chart and you'll see it's time to hook up with HP.

STANDARD NETWORKING FEATURES	HP VECTRA XM2 PC	HP VECTRA M2 PC	COMPAQ DESKPRO XE	DELL NETPLEX
Advanced Bus Architecture	PCI	VL		
Integrated Networking Interface	32-bit	16-bit		
Integrated, multiprotocol Boot-ROM	X	X		
ISA Plug-n-Play Compliant	X	X	X	
Multilevel Security Features	X	X	X	X
Asset tracking	X	X	X	
PC tattooing	X	X	X	
Optional Desktop Management Software	X	X		
Bi-directional parallel port	X	X	X	X
Desktop Management Interface (DMI) ²	X	X		



**HEWLETT®
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**HP quality in
value-priced PCs.**

- Intel 33-MHz 486SX, 50- and 66-MHz 486DX2, 100-MHz DX4, upgradable to Pentium Overdrive; Intel 60-MHz Pentium
- Chip upgrades to higher performance
- On-board accelerated local-bus video
- 210-MB hard drive¹
- 4-MB RAM, expandable to 64-MB
- 512 KB or 1 MB of Video RAM standard
- ISA Plug-n-Play compliant

**High-performance
network-ready PCs
in a slimline package.**

- Intel 33-MHz 486SX, 50- and 66-MHz 486DX2, upgradable to Pentium Overdrive
- Optional 128- or 256-KB second level cache
- 210-MB, 14-ms Fast-IDE hard drive¹
- 32-bit Fast-IDE local-bus hard disk interface
- 8-MB RAM, expandable to 96-MB
- Ultra VGA2 local-bus accelerated video supporting up to 1280 x 1024 resolution

**High-performance
PCs for the
connected office.**

- Intel 33-MHz 486SX, 50- and 66-MHz 486DX2, 100-MHz DX4, upgradable to Pentium Overdrive
- Optional 128- or 256-KB second level cache
- Four mass storage shelves; four expansion slots
- One available 32-bit VL-bus slot
- 210-MB, 14-ms Fast-IDE hard drive¹
- 32-bit Fast-IDE local-bus hard disk interface
- 8-MB RAM, expandable to 96-MB

**Exceptional 486
performance for advanced
business use.**

- Intel 50- and 66-MHz 486DX2, 100-MHz DX4, upgradable to Pentium Overdrive
- PCI architecture
- Standard 256-KB second level write-back cache
- Four mass storage shelves; four expansion slots
- Two available 32-bit PCI expansion slots
- 210-MB, 14-ms Fast-IDE hard drive¹
- 32-bit PCI IDE hard disk interface

**The ultimate PC for
advanced business and
technical applications.**

- Intel 90-MHz Pentium Processor
- Second processor socket for MP Spec 1.1 multi-processing
- Standard 256-KB second level asynchronous or burst asynchronous write-back cache
- PCI architecture
- Four mass storage shelves (three front accessible); five expansion slots
- Two available 32-bit PCI expansion slots
- 270-MB, 12-ms Fast SCSI-2 hard drive¹



HP Vectra VL2

- Desktop Power Management
- EPA Energy Star certified
- Local bus Fast-IDE hard disk interface*
- 1280 x 1024 video resolution*
- Optional 128- or 256-KB cache memory*
- Free three-year limited warranty for parts and labor²

HP Vectra N2

- 1 MB of video RAM standard, expandable to 2 MB
- Slimline package with two mass storage shelves and three ISA slots
- Optional integrated 10Base-T networking
- Multilevel security
- EPA Energy Star certified
- ISA Autoconfiguration utility (Plug-n-Play)
- Integrated Desktop Management Interface (DMI)³
- Free three-year limited warranty for parts and labor²

HP Vectra M2

- Ultra VGA2 local-bus accelerated video supporting up to 1280 x 1024 resolution
- Optional integrated 10Base-T networking
- Systems Diagnostics Utility
- EPA Energy Star certified
- ISA Autoconfiguration utility (Plug-n-Play)
- Integrated Desktop Management Interface (DMI)³
- Free three-year limited warranty for parts and labor²

HP Vectra XM2

- 8-MB RAM, expandable to 96-MB
- PCI Integrated 64-bit S3 Vision-864 graphics accelerator supporting up to 1280 x 1024 resolution
- Optional PCI Integrated 32-bit 10Base-T networking
- Integrated Desktop Management Interface (DMI)³
- EPA Energy Star certified
- Free three-year limited warranty for parts and labor²

HP Vectra XU

- Integrated 32-bit PCI SCSI-2 interface
- PCI integrated 64-bit S3 Vision-864 graphics with 1280 x 1024 resolution or PCI MGA Ultima Plus graphics with up to 1600 x 1200 resolution
- 32-bit PCI IDE hard disk interface
- 8 or 16 MB of RAM, expandable to 256 MB
- PCI Integrated 32-bit 10Base-T networking
- Integrated Desktop Management Interface (DMI)³
- Free three-year limited warranty for parts and labor²

from
\$1,049¹

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\$1,429¹

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\$1,509¹

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\$2,069¹

from
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All HP Vectra PCs come with MS-DOS® 6.2 and MS Windows for Workgroups 3.11 pre-installed; HP mouse and keyboard included. *Feature included with some models. ¹U.S. list price, dealer prices may vary. Monitor not included. ²Other capacities available. ³First year on-site, 24-hour service. Second and third year return to dealer. ⁴Available 10/1/94. ⁵With permission CRN/Benchmark. MS-DOS is a U.S. registered trademark and Windows is a trademark of Microsoft Corporation. Pentium and the Intel Inside logo are U.S. trademarks of Intel Corporation. PPG407 ©1994 Hewlett Packard Company

Sony With Soul...

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ADI delivers the reliability and quality of Sony, without the brand name price.

You want a top-of-the-line monitor. And you're looking at Sony MultiScans. But you have bottom line concerns, and you'd like to look at a cost-efficient alternative in the same league as Sony. Look at ADI MicroScan™. With microprocessor intelligence. 18-mode memory. Front panel digital controls. 76 Hz non-interlaced scanning for stunning, flicker-free images. Razor sharp resolution of up to 1280 x 1024. Special anti-glare, dark glass CRT surfaces.

And performance that meets or exceeds every standard for manufacturing, power conservation, ergonomics and safety. That's why three million ADI MicroScan monitors have been sold.

Then to sum up the differences, between Sony and ADI, look at the price tags. With ADI, the sum you save will let you go out and buy a top quality TV set for your living room.

Say a Sony.

For information on ADI, our monitors and our company, call (800) 228-0530 today. For faxed product information and editorial reviews, call (800) 767-8182.



March 16, 1993
ADI MicroScan 3E+

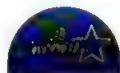


The ADI MicroScan 17" 5AP and 15" 4GP

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- Single-board design
- 2-year warranty

ADI

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New & Improved

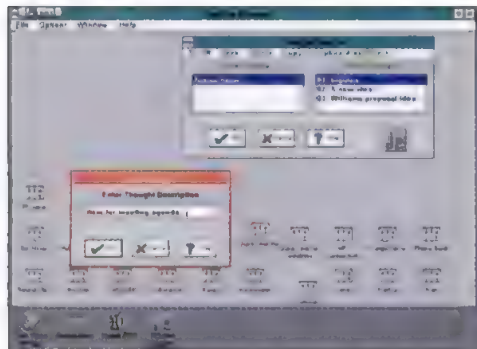
NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Jonathan Matzkin and Asa Somers

NEW

Capture Your Innermost Thoughts

Looking for something to do with the microphone that came with your sound card? Thoughts, a voice-note editor and organizer from **PC Voice**, makes voice notetaking a snap. You simply click on a menu button, say your piece, and return to what you were doing.



Thoughts lets you record and organize voice notes.

Thoughts does the rest, automatically saving the vocal note. Later, you can go back and organize your spoken notes into groups, edit them, or embed sound bites into other documents. ► **Thoughts.** List price: \$59. PC Voice, Roswell, Georgia; 404-343-8201.

Circle 406 on reader service card.

NEW

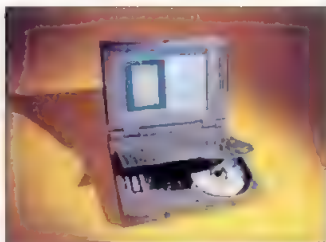
Enter the Drawing World's Third Dimension

Users of CorelDRAW and other 2-D drawing programs now have an affordable place to turn for powerful 3-D extrusion capabilities. **Visual Software's** Simply 3D lets you import drawings and text and then extrude them, add textures and light sources, and animate the resulting 3-D objects. Simply 3D is ideal for creating visually impressive elements for use with multimedia presentation packages, and the program includes 100 3-D objects and 70 textures. The package's low price belies its robust features.

► **Simply 3D.** List price: \$59. Visual Software Inc., Woodland Hills, California; 800-669-7318, 818-883-7900; fax, 818-593-3750.

Circle 405 on reader service card

HOT PROSPECT



MPC's CDBook Makes Multimedia Portable

The CDBook from **MPC Technologies** eliminates many of the hassles of portable multimedia by integrating a full-size 5.25-inch CD-ROM drive into a notebook. In addition to the double-speed CD drive, the CDBook includes a built-in microphone and stereo speakers and a 16-bit Sound Blaster-compatible audio system.

The color screen choices include a 9.5-inch active-matrix or dual-scan passive-matrix color display, both of which support a maximum resolution of 640-by-480 with 256 colors. To fit the Philips CD-ROM drive inside the notebook, MPC engineers had to take out the internal floppy disk drive and design an external drive. Each system has a travel weight below 9 pounds, and offers hard disk options up to 520MB. The notebooks can accommodate two Type II PCMCIA devices or one Type III PCMCIA device.

While other leaders in the notebook field plan similar CD-ROM systems, MPC's CDBook is the first one to give the traveling executive an integrated multimedia notebook.

CDBook 800 Series. List price: With 486DX4/75 processor, 4MB RAM, 340MB hard disk, dual-scan color display, \$3,499. With 486DX4/100 processor, 8MB RAM, 540MB hard disk, dual-scan color display, \$3,999. MPC Technologies Inc., Santa Ana, California; 714-724-9000; fax, 714-724-9648.

Circle 404 on reader service card.

NEW

IBM's Multimedia Home

IBM Personal Computer Co. has aimed its seven Aptiva systems straight at the home PC user interested in multimedia. The Aptiva units, which replace IBM's PS/1 line, meet MPC 2 standards and come with double-speed CD-ROM drives, 16-bit sound cards, fax modems, and stereo speakers. Hardware combinations range from an entry-level 486SX/33 system with a 270MB hard disk to a high-end 60-MHz Pentium system with a 727MB hard disk.

Taking power management to a new level, the Aptiva can be set to detect an incoming phone call, switch itself on, and take a message or receive a fax. The system then shuts itself off, but displays a message about the fax or phone call when you start it up again.

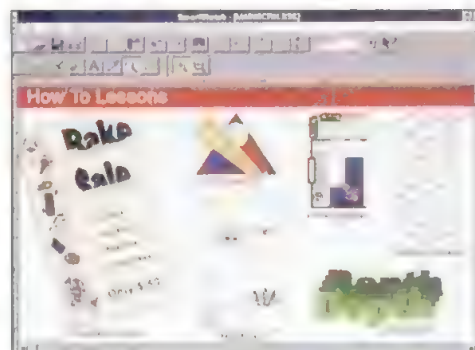
► **IBM Aptiva.** Estimated selling price: 486SX/33 CPU, \$1,199; Pentium/60, \$2,599; prices do not include monitors. IBM Personal Computer Co., Somers, New York; 800-426-3377.

Circle 407 on reader service card

NEW

SmartSketch: Quick and Easy Drawing Tool

FutureWave Software's SmartSketch combines the precision of powerful drawing packages with the unimposing spontaneity of



SmartSketch's tutorials get beginners started.

painting software. SmartSketch is intended for beginners who may have been turned off by the complexity of even rudimentary drawing programs. For instance, SmartSketch lets you

New & Improved

remove any portion of an object, move it, or reshape it—a capability more often associated with paint programs. You can also use SmartSketch's brush tool to create shapes with the mouse, as in paint packages. Instead of using complicated Bezier curve handles that may confuse first time users, SmartSketch creates curved lines by letting you grab and pull anywhere along a line or at the corner of a shape. The software comes with more than 600 images that can be incorporated by dragging them into illustrations.

► **SmartSketch.** List price: \$99. FutureWave Software Inc., San Diego, California; 619-637-6191; fax, 619-637-9032.

Circle 408 on reader service card.

IMPROVED

Canvas Gets Fonts and Clip Art

Version 3.5 of Canvas for Windows from **Deneba Software** goes beyond what's expected from drawing and illustration packages by including a CD-ROM that contains a large collection of clip art and fonts. The CD-ROM is packed with more than 10,000 editable images and more than 2,000 TrueType fonts. The images are cataloged in a keyword-indexed graphics database that offers thumbnail previews of the images. In addition, Version 3.5 now supports the Twain driver standard, so you can use any Twain-compliant scanner to scan photos and line art without leaving Canvas.

► **Canvas for Windows, Version 3.5.** List price: \$399; upgrade, \$49.95. Deneba Software, Miami, Florida; 305-596-5644; fax, 305-273-9069.

Circle 409 on reader service card

IMPROVED

QuickBooks Adds Inventory Management

New inventory management features in Version 3.0 of QuickBooks for Windows let you generate purchase orders, track goods on-hand and on-order, and produce inventory reports. The latest version of **Intuit's** small-business accounting software also lets you point and click to modify the formats of invoices and other common business forms, such as purchase orders and sales receipts. QuickBooks now has an audit trail that maintains a complete record of all changes made to accounting records, but you can still correct mistakes at any time.

► **QuickBooks for Windows, Version 3.0.** Estimated selling price: \$99; \$35 rebate for upgrades from previous QuickBooks versions. Intuit Inc., Menlo Park, California; 415-322-0573; fax, 415-322-1597.

Circle 410 on reader service card

BRIEFS

Software

Tired of those annoying "out of memory" messages when you are multitasking in Windows? AnyView Professional (\$99.95), from **Binar Graphics**, manages system memory better than Windows so that you can run several large applications at once. The utility also offers graphics acceleration, on-the-fly switching of color depth and resolution, color calibration, and power-management features. 415-703-0400

Manufistics Group Inc. has introduced a quality-control module for Statgraphics Plus for Windows that will be sold as a \$399 add-on to the base package. The new module will contain all of the statistical routines used by quality-control engineers for monitoring quality improvement, including Pareto analysis, process capability, and gauge repeatability and reproducibility. 301-984-5000

Bitstream has released the software development kit for its TrueDoc technology. TrueDoc maintains font fidelity in portable electronic documents and allows viewing of fonts across applications, platforms, operating systems, and devices. The original look and feel of the document is retained on all screens and printers. **No Hands Software** will include TrueDoc technology in Version 2.0 of its Common Ground for Windows. 617-497-6222.

Hewlett-Packard has announced LABS (Low Admin Backup for Servers), a new standard for automated network backup. LABS-compliant solutions will combine automated backup software and autoloader technology. The standard describes "zero intervention" network backup through default backup scheduling and automatic backup, in addition to a variety of other features. **Legato Systems** has introduced Staccato, the first totally automated backup product for the LABS market. 415-812-6032

A new software company called **G'Vosay** offers Takelt 1.2, a remote-access program for mobile users. The package places network files on the mobile user's hard drive, so that they

NEW

Tiny Disk, Big Capacity

What gets bigger and smaller at the same time? Hard disks. The PocketFile 260 from **Int'egral Peripherals** packs 260MB of data storage into a diminutive PCMCIA Type III card—one-third more capacity than the nearest competitor. The PocketFile 260 drive-on-a-card measures 0.41 by 2.12 by 3.37 inches and weighs just 3 ounces. Int'egral claims an average seek time of 12 ms for the disk, which is based on a pair of 1.8-inch platters and four read-write heads. The drives have been designed to withstand nonoperating shocks of 750 G, according to the manufacturer.



Int'egral's PocketFile packs 260MB on a Type III PCMCIA card.

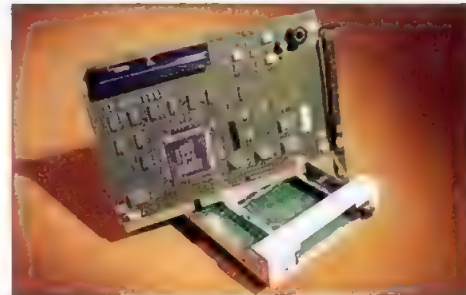
► **PocketFile 260.** List price: \$395. Int'egral Peripherals Inc., Boulder, Colorado; 303-449-8009; fax, 303-449-8089.

Circle 411 on reader service card

NEW

Add PCMCIA to Your Desktop

PCMCIA slots are now commonplace in notebooks, and they could soon be standard equipment on desktop systems. In the meantime, you can get more out of your PCMCIA peripherals by installing a card reader on your desktop PC. **SCM Microsystems**, a leading maker of card readers, is now selling a line of PCMCIA



SCM's SwapBox card reader lets you upgrade your PC with PCMCIA.



LARRY STRIKES A BLOW FOR PERSONAL EXPRESSION AT THE MANILLA VANILLA ENVELOPE COMPANY.

NEW MOUSEMAN™ SENSEA™. Who knew self-expression could feel this good. And Sensa can do so much more than just look and feel great. Like reduce bothersome double clicking to a single click, and compress tedious point and click commands to the touch of a button. Sensa. At your dealer in two alluring textures and four luxurious shades. Of course, MouseMan is still available in classic...uh...gray. To get product information by fax, call 1-800-245-0000 and request document #4028.



Power Macintosh

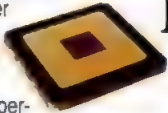
Steve Archuleta
Director, Systems for Mass
Markets Service Delivery
US West, Phoenix

During the week, Steve manages the systems and processes that support 14 million customers in 14 western states. On weekends, he dotes on his granddaughter, rushes the net on the tennis court and, "when I'm feeling daring," scales the face of local rock climbing havens.



"There's leading edge. And bleeding edge. And you

The RISC-based PowerPC™ microprocessor at the heart of every Power Macintosh takes desktop computing to new levels of performance and compatibility. For the name of your nearest authorized Apple reseller, call 800-732-3131, ext. 750, today.



have to walk the line to stay competitive.

That's why we use Power Macintosh. It's a

RISC PC, so it's leading the way. But it's

also a Mac that can run Windows and

DOS, so it's compatible with everything



"In some cases, we used to have three different PCs on one desk—an absolute monument to systems failure. So that's where we put the Power Macintosh first. Now there's one PC per desk, the Power Macintosh. One happy user per desk, too."

we're doing now. That makes Power Macintosh a



Mac OS For Windows

Power Macintosh™ fits right in at US West, where people use many different types of PCs and 30 or so custom DOS and Windows programs. "Power Macintosh helps our people collaborate, no matter what kind of PC they use."

very safe choice. Which is good for a guy

like me. I take my risks on the weekend."

Power Macintosh. The business Macintosh.



New & Improved

sockets that include floppy disk drives. SCM's SwapBox Classic Combo combines a standard 3.5-inch floppy disk drive and a PCMCIA Type III socket that mounts in a 3.5-inch floppy disk drive bay or a half-height 5.25-inch bay. The SwapBox Premium Combo adds a second Type III socket, mounted through the PC's back panel, that's suitable for a network adapter, a modem, or sound cards that require cables.

► **SwapBox Classic Combo.** List price: \$199. **SwapBox Premium Combo.** List price: \$279. SCM Microsystems Inc., Los Gatos, California; 408-395-9292; fax: 408-395-8782.

Circle 412 on reader service card

NEW

First V.34 PCMCIA Modems

Following the recent ratification of the V.34 standard for 28.8-Kbps modem transmissions, **U.S. Robotics** (USR) has announced two new PCMCIA data/fax modems. Compatible with any Type II PCMCIA slot, the Sportster and Courier V.34 Data/Fax PCMCIA 2.1 units include USR's Easy Install and CardSoft PCMCIA set-up software. The more expensive Courier model is based on flash ROM and can be easily upgraded to future data transmission standards.

► **Sportster V.34 Data/Fax PCMCIA 2.1.** List price: \$499. **Courier V.34 Data/Fax PCMCIA 2.1.** List price: \$575. U.S. Robotics, Skokie, Illinois; 708-982-5010.

Circle 413 on reader service card

NEW

Addressmate Pushes the Word Processing Envelope

CoStar Corp.'s Addressmate starts where conventional word processors leave off by adding address book management and a layout designer for envelopes, labels, and forms to Word for Windows, Ami Pro, and WordPerfect for Windows. CoStar's options appear as choices on the word processor's normal menu structure to give access to addresses from within a word processing document. Addressmate's layout designer includes more than 100 forms, from Avery labels to standard envelopes; you can also use Addressmate to prepare business cards, name tags, and other forms that mix text and graphics. In addition to operating within a word processing program, Addressmate can also run as a standalone program.

► **Addressmate for Windows.** List price: \$69.95. CoStar Corp., Greenwich, Connecticut; 203-661-9700; fax: 203-661-1540.

Circle 414 on reader service card

BRIEFS

Software

execute locally. The files appear to the mobile user, however, exactly as they would if they were remotely located, only faster than if they were called up through a modem and phone line. When the user connects to the office, TakeIt synchronizes the local and remote files. 801-374-1623

Image Master from **Accidental Software** allows the user to create visually appealing slide shows with digital images. The shareware product costs \$25 for registration and features compatibility with just about every graphics file format. You can create shows of up to 500 images and add or delete images or change the order at any time. 619-247-2804.

Funk Software's WanderLink allows traveling businesspeople to establish an IPX link to their company's NetWare server via standard phone lines as either a DOS or Windows client. The server side of the package runs as an NLM on a NetWare server. Software compression enhances remote throughput over telephone lines. 617-497-6339; fax, 617-547-1031.

If you're looking for in-depth financial information, Standard & Poor's Stock Guide on Disk is now available as part of **Design Creations'** Instin 3.0 portfolio management software. The S&P information includes a company's long-term debt, growth rate, and market capital. A subscription to S&P Stock Guide on Disk costs \$139.95. 800-289-8000, ext. 56

Hardware

Zenith Data Systems has unveiled its color Z-Lite subnotebook, which includes a backlit 7.8-inch passive-matrix display and Cyrix's Cx486DLC processor running at 33 MHz. The color Z-Lite weighs 4.3 pounds, including its nickel hydride battery. An external floppy disk drive is optional. 708-808-5000.

Boca Research has begun shipping the Sound Connection 16, a single, easy-to-install board that weds a 14.4-kilobit-per-second data/fax modem with a Sound Blaster-compatible sound

NEW

miro Sounds Off

miro Computer Products, maker of graphics accelerators and video-capture boards, has moved into the sound board market with the miroSound PCM1 pro. Based on the Yamaha OPL4 synthesizer chip, the miroSound offers both FM synthesis and wavetable audio. The package, which is Sound Blaster-compatible, includes a 7-channel audio mixer (expandable to 12 channels), 128 instrument samples, and software for sound effects and data compression.

► **miroSound PCM1 pro.** List price: \$229. miro Computer Products Inc., Palo Alto, California; 415-855-0940; fax, 415-855-9004

Circle 415 on reader service card

NEW

Speak and Listen Keyboard

One of the major drawbacks of multimedia is the tangle of wires needed to connect the microphone and speakers to your desktop PC. **MaxiSwitch**, a major manufacturer of keyboards, has integrated these major components into its Maxi Sound multimedia keyboard. The



Maxi Sound combines speakers and microphone.

package includes a pair of Altec-Lansing speakers and a stereo microphone built into a standard keyboard. The keyboard also has audio input and output jacks for connecting external components.

► **Maxi Sound.** List price: \$99. Maxi Switch, Tucson, Arizona; 602-294-5450; fax, 602-294-6890.

Circle 416 on reader service card

NEW

Shopping for CD-ROMs on the Internet

CD-ROM titles appear so rapidly that it's hard to keep track of what is available. **Spindex** offers an innovative on-line database of CD-ROM titles, accessible through dial-up (via



It runs so fast, even its price has lost weight.

■ The fastest Ethernet PCMCIA adapter is about to go even faster—because now you can buy it for just \$195* instead of \$250.

Better still, the EtherLink III PCMCIA adapter is built with 3Com's exclusive Parallel Tasking™ technology, delivering performance that is up to 110 percent faster than any other notebook adapter, according to LANQuest Labs.®

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Plus, with 3Com's AutoLink™ the EtherLink III PCMCIA adapter installs in under three minutes. Make a single menu selection to install the adapter, configure the drivers, and download NetWare® client files from the server.

What's more, the EtherLink III PCMCIA adapter is compatible with all the leading notebook computers. Guaranteed. Or your money back. You even get a lifetime warranty.

To hear more about our lower price and to get a free copy of the LANQuest Labs' PCMCIA benchmark reports, just call **1-800-NET-3Com**. But hurry. At these prices you can expect the EtherLink III PCMCIA to go even faster.



Networks That Go the Distance®

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The Spindex on-line CD-ROM catalog.

modem at 415-254-7811, 14.4 Kbps, 8N1) or through Internet telnet (discs.com 2050). You can search by platform (PC or Macintosh), price, age of target user, publisher, author, keyword, or any combination of the above. In many cases you can download a review of the title or examples of graphics from titles you select.

There is no charge for searching the database or listing titles on the database, and most listed titles can be ordered on-line from Spindex.

► **Spindex.** No charge for searching the database. Spindex, Mountain View, California; 415-254-7818; fax, 415-903-2237.

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As many executives have had to learn the hard way, the difference between making a profit and taking a loss can boil down to a few critical decisions. In order to help businesspeople make the best possible choices, **Palo Alto Software** has created the DecisionMaker software program, which utilizes many of the techniques that are taught in graduate business schools to guide the user through all aspects of an issue.

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With this clearly reasoned, logically organized information at hand, you can not only improve the decision-making process, you're more likely to have confidence in your ultimate decision.

► **DecisionMaker.** List price: \$149.95 Palo Alto Software, Eugene, Oregon; 503-683-6162; fax, 503-683-6250.

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BRIEFS

Hardware

sound card. The unit comes bundled with FaxWorks' Call Center software, which provides telephony functionality such as voice-mail and speakerphone capabilities, and Sound Impression for Windows for audio controls. The \$199 unit is one of several such hybrids that will appear by fall. 407-997-0918.

Elor TouchSystems has announced the IntelliTouch Model 1765 touch-screen monitor, which features a 17-inch flat-square color tube and provides a maximum 1,280-by-1,024 noninterlaced resolution and a refresh rate of up to 100 Hz. The \$1,980 unit is Energy Star- and MPRI-compliant and comes with MonitorMouse emulation software. 800-356-8682, 615-482-4100.

Kingston Technology Corp. is now shipping its new DataPak 170, a 170MB PCMCIA hard disk. DataPak provides transfer rates of up to 3.5 megabits per second and uses Kingston's proprietary dynamic ramp loading technology. This ensures that the read/write heads never come in contact with the disk's recording surface, reducing the risk of disk failure. The \$565 unit draws only 0.025 watts in sleep mode and 1.3 watts when accessed. 800-835-6575, 714-435-2600

Alps' GlidePoint touch pad does other pointing devices one better by making the fingertip the center of attention. Just move your finger over the 2.7- by 3-inch surface to position the pointer, and tap to click. 800-825-2577.

Dolch Computer Systems' Panel-View, at 14.2 inches diagonally, is the largest standalone high-resolution active-matrix color display. It can display 17 million colors at 1,024-by-768 resolution, and boasts a contrast ratio of 60 to 1. 408-957-6575.

Digital Vision has redesigned its parallel port frame grabber and video-scan converter so it's smaller and more powerful. The \$399.95 ComputerEyes/LPT is about the size of a PC mouse, operates in 24-bit color, and can capture frames without motion blurring or distortion. 617-329-5400; fax, 617-329-6286

NEW

CD Authoring Comes to a Desktop Near You

Optibase's MPEG Lab VCD is a complete video-CD authoring system that lets you create videodisks in real time. These files, which meet the Phillips White Book video-CD standard, can be authored into fully interactive video CDs and put onto a CD-ROM using the included CD Recorder. You can write up to 72 minutes of VHS format video to a CD-ROM disk. The system features Optibase's MPEG-4000 real-time MPEG encoder board and PCMotion MPEG playback board. The system includes CDQuadrat's video Pack and WinOnCD authoring software, and can produce MPEG, CD-i, or Video CD files. With an introductory price of \$21,995, the MPEG LAB VCD system is less costly than traditional CD-authoring systems, which have often been operated by service bureaus.

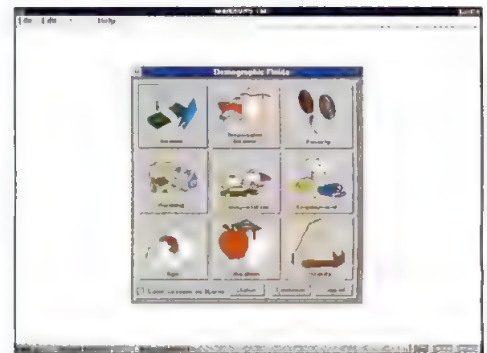
► **MPEG LAB VCD.** List price: \$21,995 (introductory price). Optibase Inc., Dallas, Texas; 214-386-2040; fax, 214-386-2295.

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NEW

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DataMap's MarketPro, Version 2.1, is just the tool for the frustrated marketer in search of buyers. The Windows program brings the benefits of market research to small businesses by matching



Click on demographic variables with MarketPro.

consumer profiles with a company's needs. MarketPro can target 174 demographic variables (including age, income, and ZIP code) to create one of 28 preformatted reports.

► **MarketPro, Version 2.1.** List price: \$499, plus \$999 per geographic region; entire U.S., \$3,500. DataMap Inc., Eden Prairie, Minnesota; 800-533-7742, 612-934-0900; fax, 612-934-8727.

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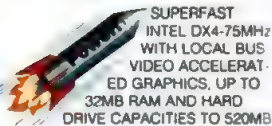
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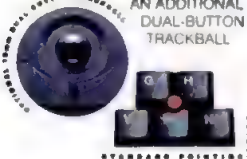
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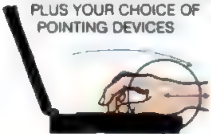
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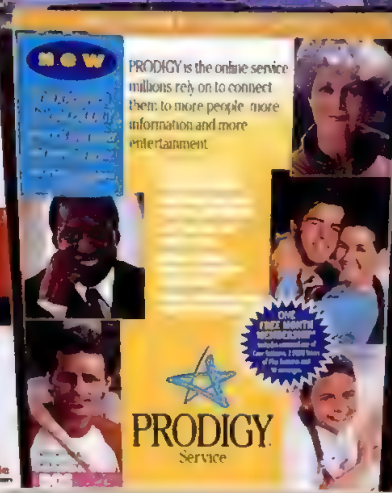
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The image displays four CD-ROM game boxes. From left to right:

- Fate of Atlantis**: Features a man in a hat and a woman in a dark, atmospheric setting. Text includes "and the FATE of ATLANTIS", "CD-ROM ENHANCED EDITION", and "A Golden Age Adventure for the Ages".
- Day of the Tentacle**: Features a cartoon character with a large nose and a tentacle. Text includes "Mystic Mansion", "Day of the Tentacle", and "A CARTOON ADVENTURE BY TIM SCHAEFER & DAVE GREENE".
- Rebel Assault**: Features a space battle scene with a large spaceship. Text includes "REBEL ASSAULT", "AN ORIGINAL ACTION-STRATEGY GAME FOR CD-ROM", and "BY VINCENT CIO".



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REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

An Artist's Best Friend

BY DANIEL GROTTA AND SALLY WIENER GROTTA

By almost every measure, Corel Corp.'s CorelDRAW 5 is the most powerful, comprehensive, and versatile illustration program for the PC—and the largest too. Therefore, it should come as no surprise that one of the best third-party books on this popular program, *CorelDRAW! 5 Unleashed*, should also be huge and heavy.

Readers might naturally expect that this 1,082-page, 4-pound monster would include just about everything there is to know about CorelDRAW 5. However, the book focuses pri-

marily on Corel's strong suit—illustration—and virtually ignores the other modules that are bundled with the latest version of CorelDRAW. A mere 76 pages are devoted to CorelMOVE, CorelShow, CorelPhoto-Paint, CorelTrace, and CorelMosaic; and there's scarcely a word on CorelVentura.

The good news is that the bulk of the book devoted to illustration is quite extensive (though not encyclopedic), logically organized, refreshingly well written, profusely illustrated (including 48 pages of color), and—the bottom line—extremely useful. The bad news is that novices may be over-

whelmed, not only by the sheer quantity of material, but by the book's lack of any introductory overview, of any definitions for unfamiliar terms (though there is an excellent glossary in the appendix), and of any sense of continuity linking everything together. The authors seem to assume that their readers are familiar with previous versions of CorelDRAW.

Even Corel experts will learn new techniques and discover shortcuts that increase productivity. Each tool or function is thoroughly explained in easy-to-understand, down-to-earth language and is accompanied with helpful illustrations. What's more, the

authors usually give an example or an exercise, with step-by-step instructions, that the reader can follow to produce the same effect. Peppered throughout the book are hundreds of one-sentence to one-paragraph information boxes—called CorelTIPs or

CorelNOTEs!—that impart invaluable, life-saving tips, tricks, and technical explanations that make this book indispensable. *CorelDRAW! 5 Unleashed* is worth its weight in gold.

► **CorelDRAW! 5 Unleashed**, by Foster D. Coburn III, Carlos F. Gonzalez, and Peter McCormick, \$49.95. SAMS Publishing, 800-428-5331. ISBN: 0-672-30517-8.

Circle 501 on reader service card



Computers from A to Z

BY SUSAN GREGORY THOMAS

It's a recurring nightmare for all computer-heads: being cornered at a party by some bubbly novice who persists in asking the most basic computer questions. Well, take heart. Next time, smile politely and recommend *Computers: A Visual Encyclopedia*.

A coffee-table-size paperback, *Encyclopedia* is a terrific, jargon-free reference book for green computer users. Its definitions are so clear and succinct that anyone from junior-high-school age on up can easily grasp the meanings; moreover, the book just looks friendly. The 371 sturdy bond pages are cleanly designed, with crisp, colorful clip art illustrating technical processes and products. *Encyclopedia's* virtue, however, is also something of a curse. In its effort to stay accessible to contemporary

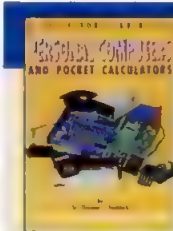
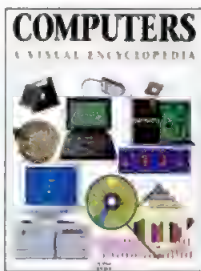
readers, the book's information will undoubtedly be dated soon.

Opening with a solid and concise introduction describing the basic mechanics and history of computers, *Encyclopedia* goes on to define over 150 terms, products, and companies common in the industry. As with

a regular encyclopedia, chapters are organized by letter, beginning with A (the first entry is

"access") and ending with Z (well, sort of—the last entry is "WYSIWYG"). A table of contents in the front and an index in the back—plus highlighted words embedded in the definitions themselves—make for easy cross-referencing.

The book's definitions are



Read Only Recommends

Whether it's stamps, coins, or baseball cards, people love to collect things. But personal computers? Why not? If you're building a PC museum, Thomas F. Haddock's *A Collector's Guide to Personal Computers and Pocket Calculators* will help you determine the historical value, rarity, and cost of that Sphere 1 or IMSAI VDP-80 you spot at your next flea market. \$14.95; Books Americana Inc., 800-726-9966; ISBN: 0-89689-098-8.

simple, not simplistic. *Encyclopedia's* writers have done a great job of anticipating the questions of curious, entry-level minds. Many entries are supplemented by "How Does It Work?" boxes, which describe to readers, step by step, how a part or application actually works.

But the telltale signs of a limited shelf life are there. References to modern-day examples in definitions—morphing on "Deep Space Nine" and in a "recent" razor commercial, for example—and discussions about "the future" of computers (artificial intelligence and virtual reality) ensure that, in a year or so, *Encyclopedia's* content will get a little dusty. Still, basics are basics, and *Encyclopedia* covers them well.

► **Computers: A Visual Encyclopedia**, by Sherry Kinkoph, Jennifer Fulton, and Kelly Oliver, \$25.00. Alpha Books, 800-428-5331. ISBN: 1-56761-464-7.

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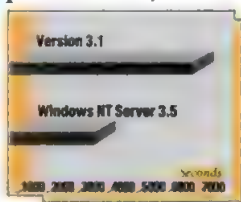
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Michael J. Miller

Making Better Connections

Every year at this time, I write a column on the general theme that communications software stinks. Guess what? Another year has passed, and while we have seen a great deal of improvement, communications software still stinks.

I get between 80 and 100 messages a day, and keeping track of them all isn't easy. Most e-mail systems seem designed for people who get far less mail. I may get more mail than the average customer, but everyone I know seems to be getting more messages every year. As the popularity of electronic mail rises, all of us will very soon face the problem of having to handle abundant amounts of e-mail. Unless the software gets better, this is going to be a very complicated task.

To handle my e-mail and messages, I have to use five different communications systems. The reason for this juggling act is that these systems don't transfer messages well from one to another. Come on, e-mail companies, this is communications software—you're supposed to be communicating.

AS COMMUNICATIONS GROW...

Internet connections and gateways have made the process of connecting systems better, but it's still not as seamless as it should be. Often attachments or binary files don't transfer properly. Electronic-mail addresses get confused easily; I often get messages sent to another Michael Miller, and that other Michael Miller gets my messages (poor guy). Finally, I still need software that tracks messages in multiple systems, and I'd love to see an integrated address book.

Still, things have gotten better. For instance, we've seen a couple of programs designed to poll multiple electronic-mail systems, such as CompuServe and MCI Mail. Notable in this group are ConnectSoft's E-Mail Connection and CyberCorp's CyberDesk. None of these programs have worked well enough for me, but I do get more mail than most folks. I use Sierra Solution's MailRoom

for Windows to connect to MCI Mail, with great results. Do I wish it had a better editor and a spell-checker? Of course. But it does work very well.

CompuServe front ends have gotten better as well, thanks to programs such as WinCIM and Navigator for Windows. Be sure to check out CompuServe's new CD, which includes its Windows front-end software, along with a better file finder and GIF viewer.

The user interfaces on all these systems lag several years behind those of, say, presentation graphics software—I'm not sure why. On the corporate e-mail front, the major PC vendors these days all offer complete suites of products, and they all spend lots of time talking about integration. But why can't you use your word processor as your e-mail editor? It's a pet peeve of mine, and I still haven't heard a good reason why you can't—just that the vendors haven't gotten around to it yet.

Speaking about integration, Lotus Notes offers great discussion databases and replication features, but its e-mail user interface is from another era. And cc:Mail has a better user interface for mail in general but doesn't even allow rich text in the editor. It's also too bad that Lotus Development, which sells both programs, can't get its act

together. But I guess with the gateways, the two development groups have trouble communicating.

...SO GROWS THE INTERNET

What's really interesting is that most of the improvements in communications have come from the area in which I expected it least: access to the Internet. No one knows quite how many Internet users there are; estimates range between 2 and 30 million. But no one disputes that there are a lot of new Internet users and a lot more information on the Net this year than last. Sud-



Although communications software has improved greatly in the past year, there is still much to be done.

Michael J. Miller

denly, every on-line service is offering Internet access.

Much of the growth has been in World-Wide Web servers, which provide graphical, hypertext-based pages to anyone with Internet access and a browser. Mosaic, the browser that brought the Internet to many (if not most) of the new users, is probably the single most important piece of end user communications software in the past five years. The tools for connecting to the Internet have improved as well. I usually use NetManage's Chameleon/NFS to connect to the Internet from my laptop, and it works great even with just a 14.4-Kbps modem.

That's the good news. The even better news is that Internet access is now being combined into operating systems, with Version 3 of IBM's OS/2 taking the lead and Microsoft Windows 95 (formerly code-named "Chicago") following. New tools such as Spry's Internet-in-a-Box promise to make Internet access easier for everyone.

And we've seen all sorts of new browsers that mainly take the Mosaic concept and run with it.

The bad news is that access is still too difficult and too confusing. None of the Internet software suites I've seen really provide the user interface and the integration that I want. Why should I have to worry about things like TCP/IP or port addresses? Why can't one user interface work for performing Gopher searches, browsing the Web, and collecting my Internet mail?

COMING TOGETHER

Another area that's seen great improvement in the past year is software designed to make it easier for people to work together. At *PC Magazine*, we're now using Lotus Notes. Its great discussion databases and forms capabilities handle discussions that formerly would have required hundreds of e-mail messages involving dozens of people. It's a big improvement.

Notes used to be the only game in town for this kind of groupware, but the market is suddenly starting to expand. Among the recent noteworthy packages are Collabra Share, which works with your existing e-mail infrastructure, and DCA's OpenMind,

which offers a unique and impressive way of viewing an ongoing discussion. Neither program, however, makes provisions for remote users.

We're also using ISDN lines and desktop videoconferencing systems on an almost daily basis to connect our offices and labs in New York with our labs in Foster City. Several of our West Coast staffers have ISDN lines now in their homes, and it's very inexpensive. (Line charges are an extra penny a minute during daytime rates.) Of course, on the east coast we're still waiting for the phone companies and regulators to notice that we've entered the nineties.

Everyone is talking about eventually having great wireless wide-area data connections. Today's solutions are either one-way, such as pagers, or too flaky and too expensive—but wireless communication is clearly on the horizon.

None of these communications solutions is quite as seamless, quite as robust, or quite as easy as you'd like them to be. But we've seen so many new packages in the last year, and the evolution is coming at such a rapid pace, that I'm much more encouraged than I have been in the past. □



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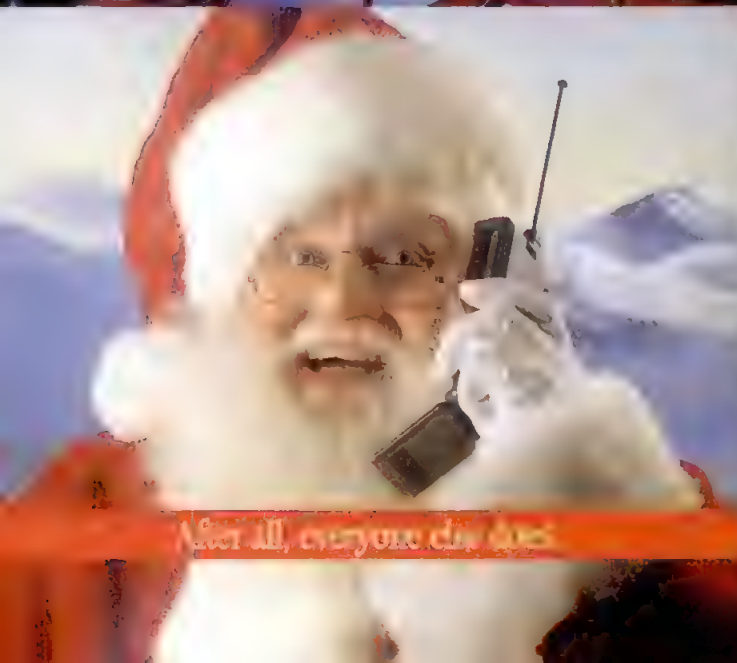
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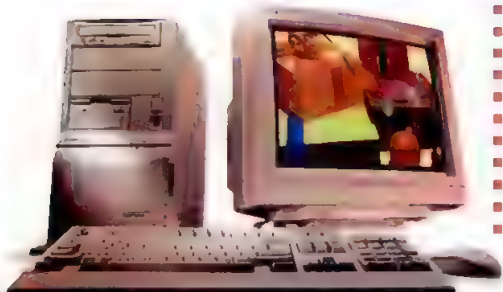
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CIRCLE 389 ON READER SERVICE CARD



Bill Machrone

A Tale of Two Pentiums

PC Magazine's product reviews are the most comprehensive in the industry, but even they can't give you the day-in-day-out experience of living with a system. Our September 27 issue covered 42 90-MHz Pentium systems. I've been living with just two

of the systems, a Micron P90PCI and a Dell Dimension XPS-90. As exhaustive as PC Magazine Labs' testing is, the difference between reviewing these systems and using them every day is like the difference between going to the prom and getting married.

Both systems are Pentium/90s, with a 1-gigabyte hard disk, a 64-bit video card, a Creative Labs Sound Blaster 16, a 17-inch monitor, and a CD-ROM drive. Both use the PCI bus for high-performance expansion boards and ISA for the run-of-the-mill cards. Both are direct-market machines. Dell, of course, virtually invented the direct market as we know it today, and Micron is America's only DRAM manufacturer. Both have won Editors' Choice awards for their machines. That's where the similarities end and the interesting stuff begins.

Micron packages its system in a slimline desktop case. It came equipped with 32MB of RAM, even though I had requested only 16 (marketing manager Ray Jones explained, "Hey, we're a memory company!"). It has a Plextor 4X CD-ROM, a Matrox MGA video card, and a Micronics motherboard. Micron does a good job of tuning the motherboard and has earned a well-deserved reputation for performance.

Micron supplies DOS and Microsoft Windows for Workgroups on CD-ROMs, so if you ever need to reload the systems or change drivers, you don't have to play the floppy-disk shuffle. The quadruple-speed CD-ROM is an expensive and hard-to-get upgrade, but it's worth it if you're planning on using the CD-ROM extensively. Programs load noticeably faster and video clips played from the CD are smoother. On the downside, the drive uses a CD caddy, which is far less convenient than a drop-in drawer. Other things that

bothered me are that Micron doesn't offer (at this writing) a mini-tower case, and its mouse hogs one of the serial ports. Three fans flail away at the air molecules—one on the Pentium, one by the card cage (which blocks a couple of full-length slots), and the obligatory one in the power supply.

In use, the Micron is breathtakingly fast. The Matrox MGA is a superb Windows accelerator, and graphics-intensive DOS games such as DOOM work just fine. I had no luck getting Myst to run with the MGA, however. That aside, the MGA is an excellent choice for high-end video add-ons. The Sound Blaster came configured for Interrupt 10, which many DOS-based games can't handle. Both the hard disk and the CD-ROM are SCSI, and the system has a SCSI-2 connector on the back panel for expansion. The Plextor CD drive croaked during testing, however, putting an end to much of my fun. But when it was good, it was very, very good.

The Dell XPS-90 is available in a mini-tower or desktop case. The mini-tower is my favorite form factor: It sits upright under your desk, takes minimal floor space, and looks great. The Dell is one of the quietest systems I've ever used. It gets by with a single, small fan—and a huge

heat sink on the Pentium. The Matsushita double-speed CD-ROM drive can't keep up with Micron's Plextor drive, but it doesn't require a disk caddy and, unlike the Plextor, it's still working. Dell builds its Dimension line with a PS/2-style mouse connector, which leaves both serial ports free. One's for the modem, of course, and the other is for LapLink, a graphics tablet, or whatever new serial device I'm currently playing with. While I have nothing but praise for Dell's use of a PS/2 port for the mouse, the Logitech-made mouse itself leaves



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CIRCLE 189 ON READER SERVICE CARD

Bill Machrone

something to be desired. The button effort is so high that your finger gets tired of clicking. Speaking of clicking, you'll never turn the machine off accidentally by brushing up against the power switch. In fact, you could lose a fingernail getting at the odd little push bar, which is recessed into the front panel.

The Number Nine GXE is a good, all-around choice for a 64-bit graphics board, or at least it will be when the drivers are done. The advertised feature set is still incomplete, and Dell representatives have expressed some frustration at Number Nine's tardiness in delivering the finished drivers. I've experienced some freeze-ups with Myst, which I attribute to the video drivers. I also get some minor weirdnesses in higher-resolution modes. In case you want a convincing if somewhat trivial illustration of how much faster the Matrox board is than the Number Nine, the winning cascade screen in Solitaire completes in roughly half the time. Number Nine has promised new video drivers and a BIOS revision for the beginning of October.

Both of these systems have a 1GB hard disk, and I've come to the conclusion that this is the capacity you need, especially if you have a CD-ROM drive. Every CD-based program you install takes at least 4 to 8 megabytes. I've already blown through 600 megabytes. You might want to think twice about how you organize that much storage, though. When the drive is configured as a single partition, the file system allocates 32K for even the smallest files. Applications that store many small files, such as e-mail or on-line-service front ends, will be wasting megabytes of space in short order.

Finally, a word on monitors. Dell's 17-inch is made by ViewSonic, while MAG InnoVision makes Micron's. Both are very good. 17-inch monitors really do fit in most places where you would put a 14- or 15-inch. It's only an inch larger in each external dimension than an NEC MultiSync 4FG, but its nearly 2-inch-greater diagonal screen size gives you close to 30 percent more viewing area.

Both of these machines, like virtually every other 90-MHz Pentium, push the state of the art. You'll spend time hassling with drivers, cruising on-line support forums, and reconfiguring the systems. You'll be rewarded with the best performance you can buy—this week. □



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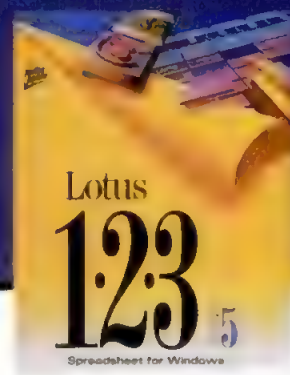
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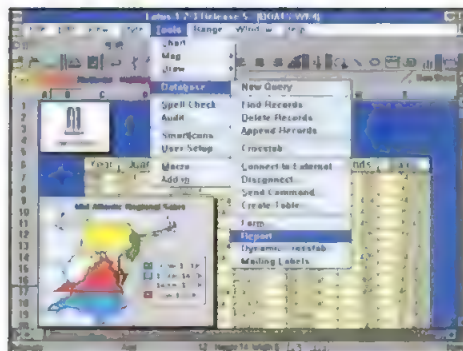


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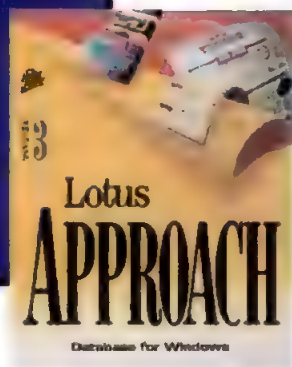


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John C. Dvorak

Windows NT Is in Your Future

Put two and two together and you'll see that Microsoft Windows NT is in the best position to win the operating system wars. Microsoft, in fact, will see to it. By stalling on Chicago (which I'm now dubbing an "insincere" product) and recently issuing edicts

to software developers about use of the Windows logo, Microsoft has signaled its true intention: To make Windows NT the desktop standard. If anything comes of Chicago, it will be the last hurrah for the single-processor Intel x86 platform. Multiprocessor Pentium computers are the next wave, and it just so happens that NT can handle symmetric multiprocessing.

It's also likely that Microsoft will release Windows Classic (or Windows Legacy or maybe Windows 4) into the marketplace after the release of Microsoft Windows 95 (formerly code-named "Chicago"). In a Coca-Cola maneuver, Microsoft could rake in an easy billion. There have been rumors of another Windows hiding in Redmond. It could be a Chicago upgrade or a different "flavor" of Chicago. I'm convinced it's Windows Classic.

The kicker is that software developers have been coerced to write code for Chicago under the threat that it'll be the only operating system out there. And if you're not Win32-compliant, you won't get the Windows logo—period. Meanwhile, Microsoft shows so little confidence in Chicago (do I really want to call this thing Microsoft Windows 95?) that it hasn't ported the interface to Windows NT. The company wants to see the reaction to the new interface before committing to it completely. This whole Chicago mess, from the early specifications to the current lackluster iterations, looks more and more like market testing to me.

What a coincidence that Chicago code can be moved easily to Windows NT. Once and for all, this ends the shortage of Windows NT applications. If it wasn't Microsoft's strategy from the beginning, it's a pretty good one now.

What happens next? Windows NT ends up on the PowerPC released by IBM and others. Heck, with all those NT apps, who'd want

anything else? It'll be ported quickly to the Apple Macintosh PowerPC machines. After all, with all those NT apps, who'd want anything else? And of course the Intel platform will go multiprocessor to keep up with PowerPC performance. Then you can run OS/2 for Symmetrical Multiprocessing or Windows NT. And, gee, with all those NT apps, who'd want anything else?

The Chicago delay is another sign of insincerity. Microsoft needs to see what IBM will do when it rolls out its PowerPC without the Workplace OS. And Microsoft needs to see which Taiwanese companies will jump on the PowerPC platform. It wants to get as much information as it can about Compaq's intentions of promoting a new architecture. It also needs information on Intel's intentions to develop a new architecture with HP. Both of these new architectures are candidates for Windows NT. (Look at all those apps!)

Finally, Microsoft needs to see what the Apple PREP (Power Reference Platform) machine looks like when it rolls out in February. This box with a PowerPC 604 chip and a PCI bus should be a screamer. Though Apple hopes to control its own destiny, the wonderful Mac OS will obviously die on this machine. Microsoft already has most

Mac app developers porting to Windows 3.1; forcing them into 32-bit Windows will make all the code available for Windows NT. Few Mac owners will be able to resist the boatload of apps.

As for the Windows NT interface, rumors are already flying that Microsoft may put a Presentation Manager on NT so it'll look exactly like OS/2. I expect that a Mac-like interface, a Motif interface, a Chicago interface, and a Windows Classic interface will make Windows NT all things to all people. And besides, with all those NT apps, who'd want anything else?



What a coincidence that all those Chicago applications can be moved to Windows NT.

A close-up photograph of the dashboard area of a 1964 Ford Mustang. The word "Mustang" is prominently displayed in a stylized font on a dark background. Below it, there are several circular gauges and indicators, including a speedometer and a tachometer. The overall design is characteristic of the mid-1960s Ford styling.

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John C. Dvorak Inside Track

A

And for Our Next Impossible Feat Dept.:

The highlight of the recent news barrage was the announcement that Fuji has developed a 3.5-inch **floppy disk** with a capacity of **100 to 200 megabytes** of memory. The company says it will replace (and potentially ruin) the market for magneto-optical drives. When I see such breakthroughs, I'm forced to recall other recent breakthroughs. A technology called digital paper that was to be released by Iomega immediately comes to mind. I also remember seeing a unique camcorder from Samsung that used 4-mm (DAT) tape some years back. It was going to revolutionize things. Let's just say breakthroughs of this magnitude make me **skeptical**. But if it works—Hey! I want one!

Another interesting announcement came from Palm Computing. These are the people who did the software for that little Zoomer personal digital assistant from Radio Shack. They claim to have handwriting recognition that is **100 percent accurate**. At least according to a news report. Since half the time I can't even read my own writing, I'm wondering how this can be possible.

Making the impossible happen seems to be a theme this month. The gossip columnist from Infoworld, Robert Cringely, and I did our yearly joint speech at the **Windows Solutions Show** in San Francisco recently. He publicly bet me \$100 that I'd have a **500-Kbps (uncompressed) connection** to my machine over normal phone lines by this time next year. Apparently he's seen some odd thing or other that convinced him this is actually true. I hope he makes them pay the money he's going to lose. My advice: Don't throw away your V.34 modem. 28.8 Kbps is here to stay. There may be a V.34bis modem in the next few years, but few observers expect it to go much faster. **40 Kbps seems possible** on ordinary phone lines.

While on the Subject of Breakthroughs Dept.: It's a shame: Hewlett-Packard has decided to bow out of the disk drive market, which it recently entered to make small disk drives that can be plugged into the cartridge slot of the HP Laserjet printer. The cute Kittyhawk 1.3-inch hard disk is no more. They were great **conversation starters** at trade shows. Funny, I don't recall ever seeing one actually used in a product. Maybe that's why Hewlett-Packard stopped making it.

Joke of the Week Dept.: So it's noted by a former

*Two years from now,
we'll be facing a
screwball world of
PowerPC chips, Compaq
chips, PA-RISC/86
architecture from
HP/Intel, Cyrix M1x
designs, and who
knows what else.*

president of the Association for Computing Machinery that Microsoft named Chicago "Microsoft Windows 95" as incentive for the coders. "They'll be hard-pressed to take it into 1996 with that name!" My comment: Anything is possible!

Do We Have To Read This in England Dept.? Apparently the **mini-feud** between Compaq and Intel has reached the boiling point. At least that's the sentiment in Great Britain, where the *Financial Times* reported that Compaq chief Eckhard Pfeiffer voiced concerns about Intel's strategies. While no analysis was made, many of the computer makers that still do their own engineering are getting miffed with Intel and its systems business. But this was **down-**

played by the comment that Compaq was upset by the "Intel Inside" ad campaign, which I don't believe is that big a deal.

If you didn't know, Compaq may well go off and do some chip designing of its own one day soon. Two years from now we'll be facing a **screwball world** of PowerPC chips, Compaq architecture, PA-RISC/86 architecture from HP/Intel, Cyrix M1x designs, and who knows what else. This industry is not dead yet.

So What Is Borland Up To Dept.: While Borland seems a bit out of the picture for now, there are rumors flying about some sort of **Visual Basic killer** code-named Delphi. Every time it's explained to me, I can't figure out what it's supposed to be—but I'm assured it's very cool. After all, somebody has to keep Microsoft from completely dominating programming languages. There's a fear that if Microsoft is the only player in the field, it may begin to charge a **run-time fee** for code generated from the compilers.

One CEO friend of mine recently expressed this dread and cited Borland's aborted attempt to charge a fee some time ago. The idea went **down in flames**. At some point, Microsoft's phenomenal revenue growth will sputter and require the company to look for new avenues of income. This is one of them.

So I finally got an Ambra machine about a week before IBM shut down the Ambra operation. The Ambra concept was a strange and pointless idea from the beginning. The machine, which was engineered in Europe, is one of the **wierdest PCs** I've ever encountered. The Pentium processor has to be slowed to a snail's pace before OS/2 can be installed on the machine, which makes no sense to me. It crashes for no good reason. And the sound subsystem speeds up everything to sound like a song from an old Chipmunks album. "Alvin!" Good time to cash out. □



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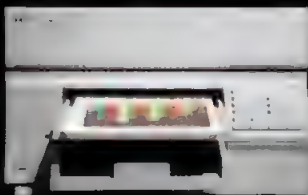


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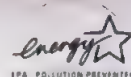
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numbers that resemble NBA scores, VL-Bus and PCI and PCMCIA, hard disks with CD-ROM-like capacities—you're sitting there with that '57 Ford on your desk.

The video is so slow you call your mother during screen rewrites. The hard disk is so slow and small you call it Floppy. The CPU chip is out of production. And the four megabytes of RAM that once seemed vast now force your Windows swap file to perform so many virtual-memory tricks that Sludgo, your semiaffectionate name for the pitiful thing, slows to a crawl.

But the boss says no when you subliminally slip "new computer" into your quarterly-review presentations. Or your spouse reminds you that your house payment has almost doubled this year, thanks to your brilliant decision to change to an adjustable-rate mortgage last year.

No new PC for you for now.

Those who can keep their heads while all around them are getting new PCs are few and far between. And probably not widely represented among the readership of *PC Magazine*.

Still, there are ways. Money wisely spent on incremental upgrades—a lot less money than you'd have to spend on a new system, even at today's prices—can help salve the pain of watching your best friend recalculate a 200,000-cell worksheet in less than a second.

PUMP UP THE PC

Before you sign up for a 12-step program for New PC Lust, consider Jim's Little List: relatively cheap steps you can take to help keep your composure when those big meanies kick silicon in your face.

Fast Video. Everything here will noticeably improve the performance of your aging PC. But if your PC is more than a couple of

years old, I suspect nothing will make such a greatly perceived difference as a fast new video card.

Don't mope about having to put up with your old ISA slots while everyone else is going PCI or VL-Bus; buy a really hot ISA board.

I've gone through stacks of current ISA video boards, trying to find one that performs close to the speed of PCI and VL-Bus boards. The best I've found is ATI's GraphicsPro Turbo, which really screams. It can't quite match the hottest PCI or VL-Bus cards, but I'll bet it's dramatically faster than the built-in video, or older video adapter, in good old Sludgo.

You'll pay about \$370 for a GraphicsPro Turbo with 2MB VRAM. If that's too much to spend, try ATI's slightly slower Graphics Xpression, a value-leader with 2MB DRAM, at about \$250.

RAM, RAM, RAM. Increasing RAM from 4MB to 8MB makes a real difference in a Windows or OS/2 machine. I wouldn't put any more than that in an older machine (you won't be able to move those SIMMs up to your next PC), but don't worry: 8MB makes a *big* difference. Expect to pay \$160 to \$175 for 4MB of RAM these days—but RAM prices fluctuate from day to day, so shop

around. (If you don't use a GUI such as OS/2 or Windows, don't bother with RAM upgrades; the pay-back will be zilch.)

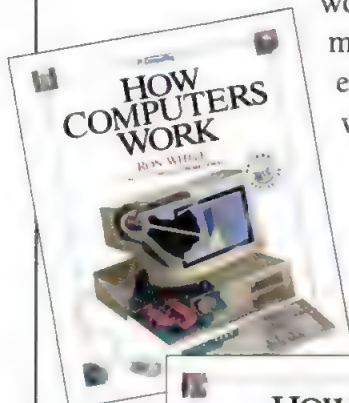
Mondo Disko. I'm impressed with the performance of the new Enhanced IDE and Fast ATA drives. If you already have a SCSI adapter in Sludgo, by all means stay with SCSI for any hard disk upgrades. But if you're running an older 80MB to 250MB standard IDE drive, probably off an IDE controller embedded in your system's motherboard, you'll be knocked out by the increased performance of a



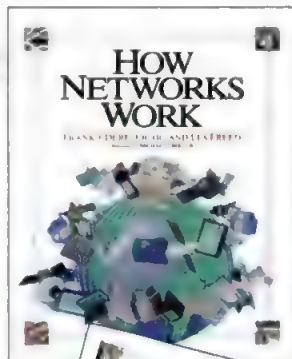
Incremental upgrades to your PC can speed it up, and allay your pangs of New PC Lust.

Imagination. Innovation. Insight.

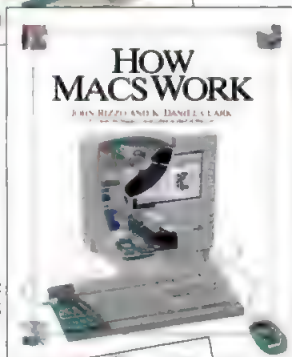
No other books bring computer technology to life like the *How It Works* series from Ziff-Davis Press. Lavish, full-color illustrations and lucid text from some of the world's top computer commentators make *How It Works* books an exciting way to explore the inner workings of PC technology.



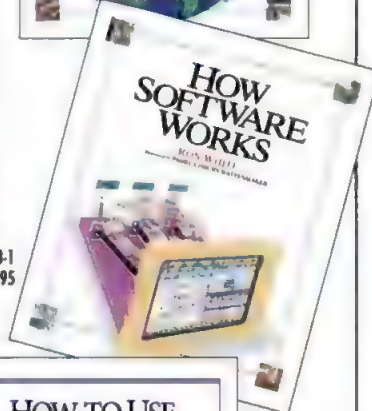
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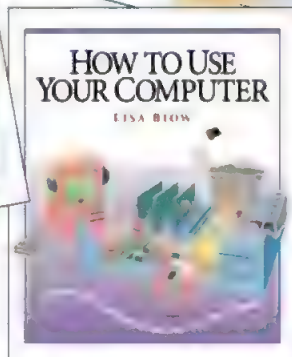


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Jim Seymour

new Enhanced IDE drive driven from an inexpensive Enhanced IDE-compatible "paddle card."

Talk with the maker of your PC before making the jump: You may need a BIOS upgrade, too. But spending \$350 to \$375 for a 530MB Enhanced IDE drive—or maybe \$700 for a 1GB drive—will be money well spent, if you're planning to stay with that machine for another year or more.

CPU Sanity. Now comes the tough call. Moving up to a faster CPU adds enough to the tab we're running here to bring us perilously close to the price of a genuine new PC. Before you spring for a CPU upgrade in any form, think carefully about how long you think you're really going to keep your current box. If you're sure you'll have it for another two years or more, it's probably worth upgrading the CPU. Any less time and that CPU upgrade isn't a smart buy.

If you decide to upgrade the CPU, go all the way with a motherboard replacement. I don't think much of these crab-like gizmos that plopp a new CPU atop your old one. The ones you can afford don't make much of an improvement; the ones that do juice up performance substantially cost an arm and a leg. Alternatively, you could drop an Intel OverDrive chip onto your existing motherboard, but you can probably buy a whole new motherboard for not much more.

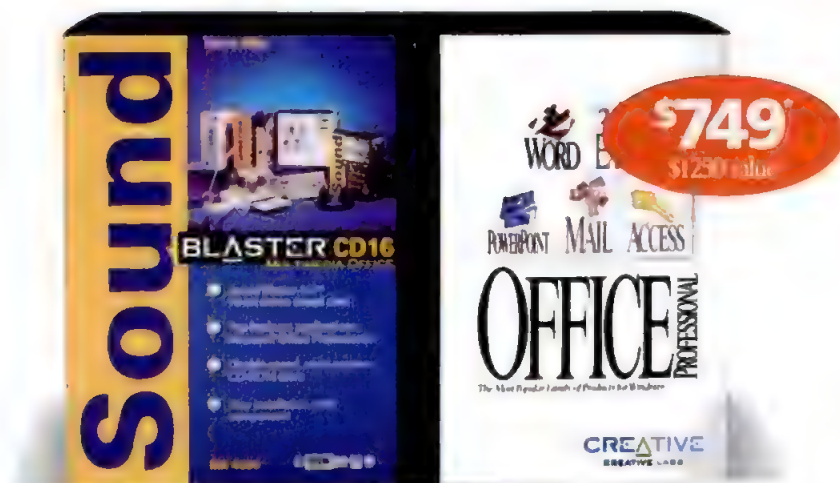
I've seen great prices on new motherboards equipped with IBM's 486SLC2/66s; you can buy a zero-memory board for as little as \$199. The dealer selling that board will add 8MB of RAM for another \$325 or so—the same as you'd pay to do the job yourself, but with the comfort factor of having the installation and testing handled for you. These are bare boards, without video, disk controllers, or I/O channels, so consider what you have in your box now that you can re-use.

Does this really make sense? Wouldn't it just be better to buy a new machine? *Of course!* Upgrading an existing PC is always more of an economic decision than a technological one, and with PC prices dropping fast, the calculation is tougher than ever.

But hey, we began with the premise that you're *not* going to get a new box. So pump up the old one, and stop going for coffee every time you spell-check a file. All that coffee's not good for you. Didn't your mom tell you that when you called her a few minutes ago? □



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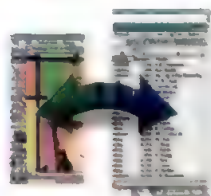
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Invasion of the 64-bit Graphics

The squadron of 64-bit graphics accelerators from ATI – the GRAPHICS PRO TURBO, WINTURBO and GRAPHICS XPRESSION – has landed. Affordably priced from only \$179, they're attacking computers with rocket-like performance, laser sharp graphics and galactic true colors.

Hi-res, True Color Universe

Resistance is futile. High resolutions of up to 1280x1024



WinSwitch

Change resolution and color without exiting Windows

and 16.7 million true colors will overwhelm you. These advanced accelerators propel applications faster in true color than other cards using just 256 colors. And superior performance – up to 42 million Winmarks* – will conquer even the most complex applications. Plus, flicker-free display – up to 100Hz – reduces eye-strain over prolonged periods of attack.



EDITOR'S CORNER

"When it comes to pure performance, the GRAPHICS XPRESSION towers above its competition. ... even outran leading VRAM boards such as the Diamond Viper Pro and the Matrox MGA Ultima ..."

PC World, 09/94

"The GRAPHICS PRO TURBO is the fastest board we've ever seen."

PC World, 09/94

"(GRAPHICS PRO TURBO) ATI not only has the edge in true-color acceleration, but, on average, it takes first place in AutoCAD tests ..."

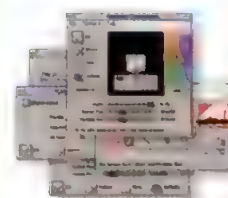
Computer Shopper, 09/94

(GRAPHICS PRO TURBO) ... 8.6: top score in test of eight PCI graphics cards

Infoworld, 07/25/94

Propelling Windows

Armed with an arsenal of utilities to enhance Windows, the mach64 graphics



FlexDesk+

For enhanced operation and complete control of Windows options

accelerators breeze through Windows applications quickly and effortlessly.

The unique WinSwitch feature allows

color and resolution to be changed – without restarting Windows. And features like FlexDesk+ and DeskScan allow you to easily customize your Windows environment, or pan and scroll across a large virtual desktop space.

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* Results using WinBench 4.0 and PC Bench 8.0. All performance tests done on a Pentium 90MHz, 16MB RAM, 256K cache, 420MB HD, using 2MB and 4MB PCI graphics cards using WinBench 4.0 at 1024x768 resolution with 256 colors (large fonts) or 800x600 in 16.7M colors (small fonts) at 70Hz refresh rate. Performance may vary for other operating systems and system configurations.

** Suggested US retail price, dealers may sell for less.

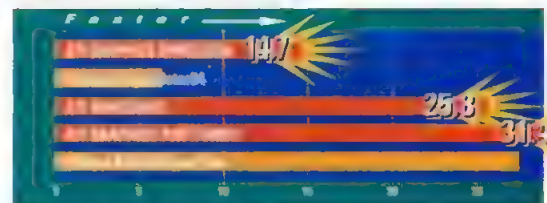
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WINBENCH 4.0 - 16.7 million colors



WINBENCH 4.0 - 256 colors



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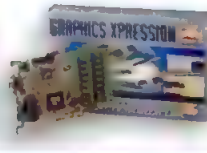
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July 25th 1994



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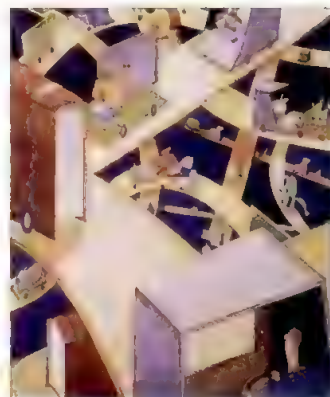
Network utilities—vital, but set aside 100K



DOS 6 utilities—handy, but about 120K



Multimedia—fun, but can you spare 50-80K?



Internet utilities—where will you get 120K?

If you don't have QEMM 7.5, what else have you sacrificed?

Sooner or later, as you push the limits of your PC's capabilities, you will run into a wall. Memory limits. Drivers that won't load. Crashes. "Out of Memory" messages. And you'll run into this wall whether you have one megabyte in your PC or 16.



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Our newest QEMM takes into account the greater demands you're putting on 'conventional' memory today: device drivers, sound cards, disk compression, caches, network utilities, CD ROM drivers, etc. Not to mention all the stuff you want for tomorrow, like the drivers you'll need for Internet utilities. It finds room for all those things so you don't have to sacrifice capabilities you want—now or in the future.

MemMaker, the memory utility that comes with DOS 6, does an OK job of delivering additional memory, but it just hasn't kept up with demanding users.

Say you wanted to run a mouse, sound card, SmartDrive, your DOS 6 and Novell utilities, and your Microsoft Bookshelf '94 CD ROM. You couldn't with MemMaker. Not unless you were willing to manually

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'tune' it. And then you might end up with 490K or so to use. But QEMM 7.5 routinely returns 634K of conventional memory. And when you consider as little as one 'K' of memory makes the difference between a program loading or not, you can see where an additional 140K or so could be vital.

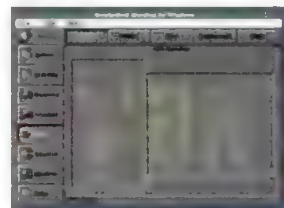
A side benefit of running QEMM is that with memory 'elbow room' you get more reliability—fewer crashes and hangs. And some programs (especially games) run faster and smoother.

When you run DOS programs in Windows, QEMM 7.5 will provide benefits for those programs, too. Many productivity programs won't even run without it unless you sacrifice drivers and other goodies.

QEMM 7.5 comes with a new version of our award-winning memory utility, Manifest, which reports details you can't find out any other way—like how Windows and the programs running under it are using memory or what software is using your IRQs.

There are dozens of new features and improvements to our new QEMM, making it even faster and safer. Find out for yourself. Visit your favorite software dealer or call (800) 571-4860 for a free brochure.

Stop making sacrifices. Get QEMM 7.5—the safest, most powerful memory manager for Windows, DOS and games.



Our new Manifest memory analyzer now runs in Windows. And it's still free with QEMM.



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Bill Howard

Talking Printers?

If you were the betting sort, what kind of odds would you have given three years ago that we'd have color laser printers that could carry on intelligent conversations with the PCs they're attached to?

Elsewhere in this issue, you'll read our reviews of 109 new printers tested in PC Magazine Labs. Here, I want to offer you a personalized snapshot of several printing technologies that do and don't make sense, starting with printers that talk to their PCs with a limited vocabulary.

MAW! Where are you? MAW (Microsoft at Work) is another of those self-proclaimed paradigm-shifting technologies from you-know-who. If and when it catches on, printers, copiers, fax machines, telephones, and maybe PDAs will all be able to talk to each other seamlessly. Right now it's a way for Lexmark WinWriter 600 printers to tell their PCs—via the Windows Printing System component of MAW—that paper is out, that the cover is open, or how many seconds remain on the print job. By year's end we'll also see a couple of MAW fax machines.

A year ago 60 vendors pledged support for MAW. This year most are MIA. As with Plug and Play, the current rallying cry seems to be, "Wait till Chicago!" You probably won't miss much if you take a bye on this technology for another year.

Dumb GDI printers, RIP. Around the time laser printers first ducked under the \$1,000 price barrier, enterprising printer makers thought: "If we take the CPU out of the printer and use the one inside the PC to image the pages via the Windows GDI, we could get the price way below \$1,000." NEC did the best job implementing this technology with the Silentwriter SuperScript 610, but this dumb (or host-based) printer sold for about \$600 to \$700 at a time when you could find roughly equivalent performance in a controller-based printer for \$100 less (and they didn't require you to do all your printing in Windows). Some graphics-intensive pages, however, did print faster if you had a 486 or Pentium CPU.

The Lexmark WinWriter is also a GDI printer that uses the PC's CPU, but only in concert between the printer's resident controller and CPU. This load-balancing scheme makes sense, although I think it makes greater sense to equip a printer with a fast (and cheap) RISC processor such as the AMD 29030.

Think duplex, save money. The second-surest way to cut printing costs is with a duplex printer, one that flips each page over and prints on the back side as well. (The surest way to save is to read the document on-screen and never print it.) And when you travel, or carry documents home at night, there's less space taken up in your briefcase. Using duplex printing, you can get 500 pages of information in an inch-high pile. That's manageable; 500 sheets (5 pounds of paper) is not. You also save \$2.50 every time you go through a ream of paper.

For duplex printing to be more successful, we need smarter software. For starters, software that prints schedules on half-sheet daily organizers ought to be able to line up the front and back pages.

Think big, think tabloid. Serious spreadsheets spill far beyond A-size (8.5- by 11-inch) sheets of paper. Every department deserves at least one B-size (11- by 17-inch) printer, whether it's a \$350 personal ink jet printer such as the Canon BJ-230 or a fast laser printer such as the 20-ppm Xerox 4520mp.

Label printers. No matter how good the software you install might be, traditional printers still handle envelopes and labels grudgingly. For \$150 to \$250, you can get clock-radio-size devices from Brother, CoStar, and Seiko that produce labels you can stick on envelopes, or that print directly onto envelopes. They only seem hard to cost-justify before you get one. □



*Don't be surprised to find yourself
having a conversation with
your printer in the near future.*

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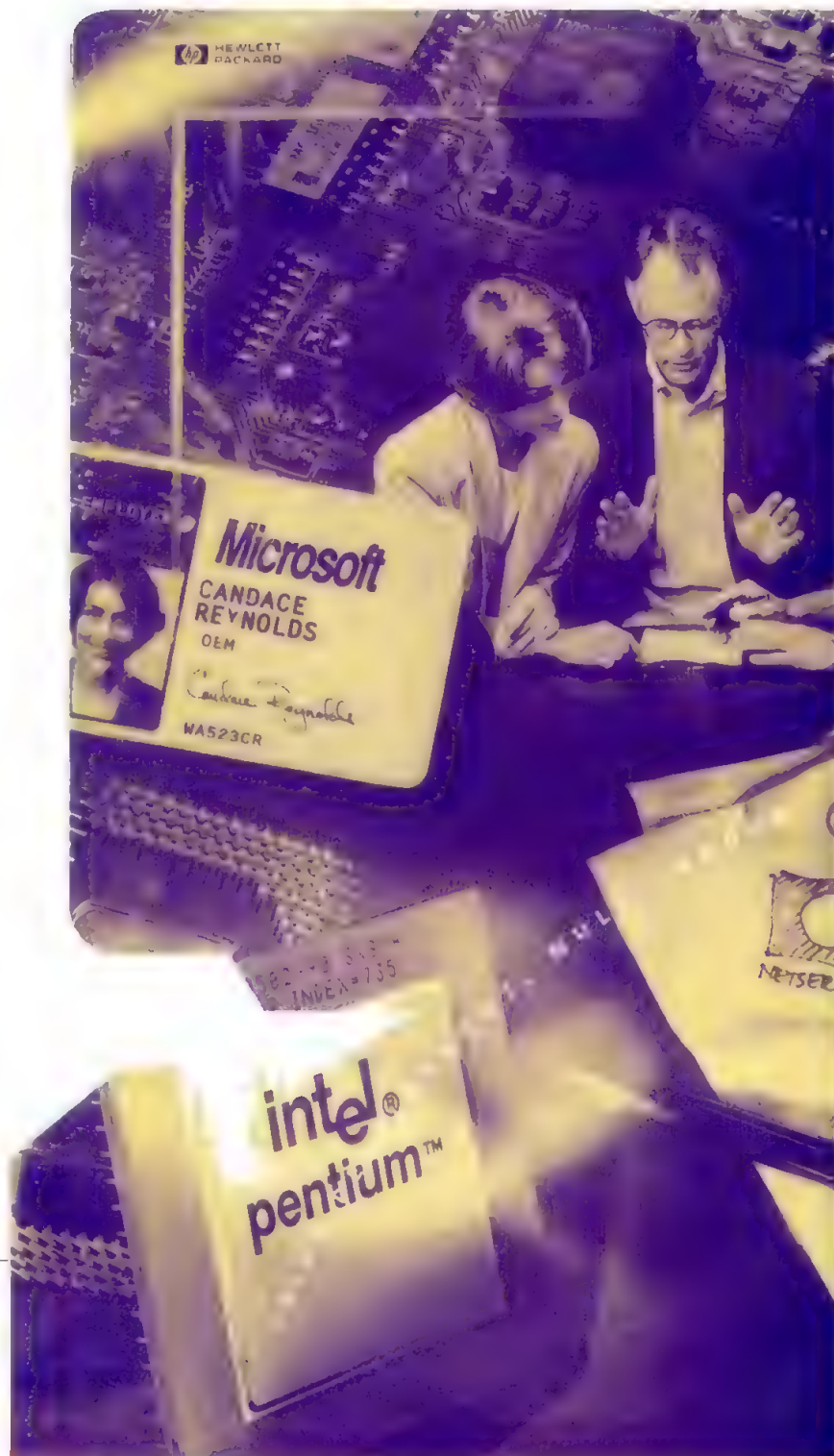
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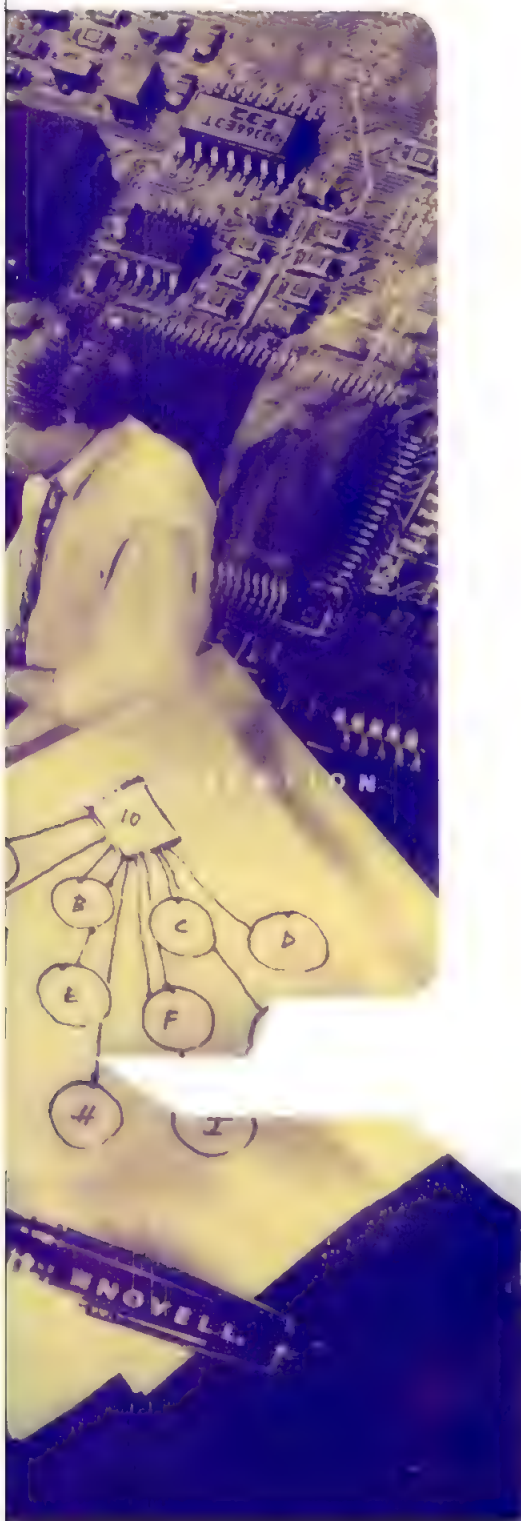
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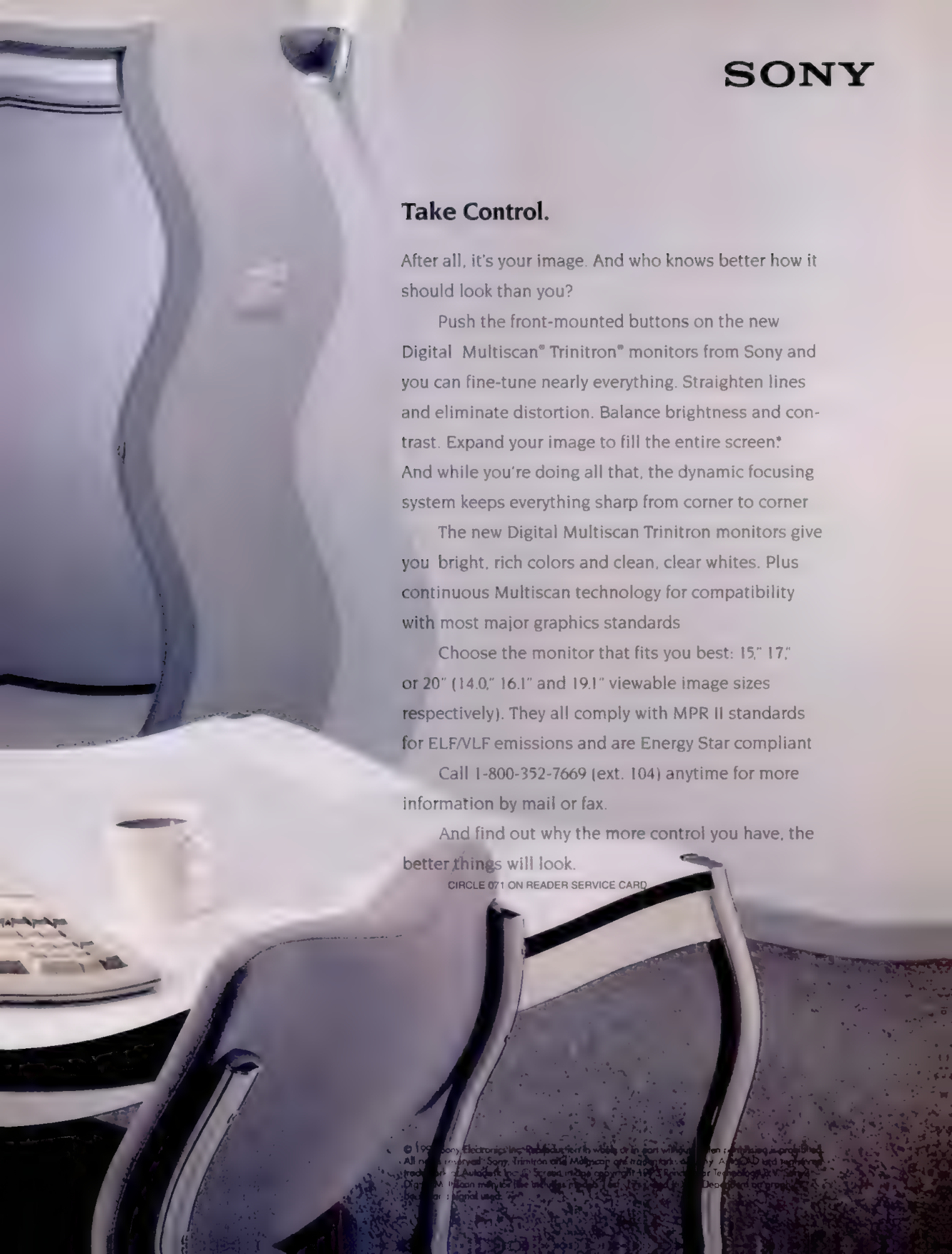
And you can start by talking to Hewlett-Packard. Together with partners like Intel, Microsoft,[®] Novell and others, we're developing technology that ensures true compatibility, across the board and across the network. So your PC runs everything it's supposed to, wherever it's supposed to.

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11th Annual Printer Issue

Color is everywhere in the printer market now. And everything is cheaper this time around. Topping our news are affordable color ink jets, a color laser from HP, and personal lasers for less than \$400.

Over the next 100 pages, you'll see 109 more reasons why the office won't be a paperless office anytime soon. The products reviewed in *PC Magazine's* eleventh annual printer issue represent new highs in affordability, speed, resolution, and color.

Last year we saw laser printers sell for less than \$500. This year they've fallen to less than \$400. This year we're seeing 12-page-per-minute laser printers selling for about \$1,400—the same price that 8-ppm printers sold for a year ago. The majority of laser printers now offer 600-dot-per-inch resolution. And more than half of ink jet printers now offer color capabilities. The color ink jets have been joined by three color laser printers, including the much-anticipated Hewlett-Packard model.

It was ten years ago that Hewlett-Packard brought out the industry's first laser printer, the 71-pound, \$3,495 LaserJet, and ten years, too, since it brought out the first ink jet printer. HP is firmly ensconced in first place in both product categories, and along the way the two dominant technologies

By Bill Howard



of a decade ago—which HP never bothered to chase—have ceased to matter: daisy wheel and dot matrix printers.

The market for dot matrix printers will shrink by 26 percent this year; nonetheless, research firm BIS Strategic Decisions of Norwood, Massachusetts, projects sales of 2.4 million dot matrix units next year out of a total printer market of 12 million units. As a whole, the printer mar-

ket will grow by 4 percent a year, BIS says, including a 12 percent increase in laser printer sales and a 40 percent increase in ink jet sales.

TRENDS: COLOR EVERYWHERE

Two trends really stand out this year. Probably the more visceral of the two is the near-universal access to color. A year ago, the color ink jet printer was an anom-

aly. This year, 10 of the 19 ink jet printers we looked at are color-capable. You'll generally find three levels of mainstream ink jet printers: A monochrome-only unit for \$200 to \$300; a three-color unit for \$300 to \$400; and a four-color version for about \$500 to \$600 (all *street* or selling prices).

High-quality color printing is done with four colors, cyan (pale blue), magen-

Printer Technologies: Which One to Choose?

This table summarizes the pros and cons of units in the five major printer categories. These comments apply to most printers within each category. High-end color ink jet printers such as the HP DeskJet 1200C and HP DeskJet 1200C/PS should be considered color printers, as well as ink jet units. The cost-per-page numbers do not include paper costs (which normally run about a penny a sheet). The speeds of laser and dot matrix printers are not directly comparable, but a rough rule of thumb is that 1 page per minute (ppm) from a laser printer equals 30 characters per second (cps) when printing a full page of double-spaced text or 60 cps when printing a full page of single-spaced text.

	Dot matrix printers	Ink jets	Personal/workgroup lasers	Departmental lasers	High-end color printers
Pros	Inexpensive, with lowest-cost output. Can print multipart forms and on wide paper.	Quiet, compact, good print quality. Most do color. \$200 less than the least expensive lasers.	High print quality. Quiet, compact, more energy-efficient. Prices as low as \$399.	High print quality, very fast. Can handle 11- by 17-inch output and have multiple bins available.	Excellent output; printouts from the best units match color photographs in terms of quality. Units save money for graphics and prepress users.
Cons	Print quality can't keep up with that of ink jets. Unacceptable color; noisy. Quality decreases as ribbon ages.	Cost per page is higher than with dot matrix, slightly higher than with lasers. Smearing remains a problem with some units.	Least expensive laser models. Many don't have RISC CPUs, and print graphics slowly. Units may need RAM upgrades to print full pages.	Some units are difficult to install and manage. Printouts are in a common area where anyone can see them.	High initial investment. Bulky, slow. High cost per page.
Speed	Personal models, 25 to 150 cps; line printers, up to 500 cps.	Text, 50 to 150 cps (equal to about 1 to 3 ppm).	Personal models, 4 to 6 ppm; workgroup models, 8 to 12 ppm.	16 to 32 ppm.	Solid-ink, thermal wax models, 1 ppm; thermal dye transfer models, several minutes per page.
Cost	Personal models, \$100 to \$300; multipart-form and line printers, \$500 to \$8,800.	Monochrome models, \$200 to \$300; three-color models, \$300 to \$400; four-color models, \$500 to \$700.	Personal models, \$400 to \$1,000; workgroup models, \$750 to \$1,500.	\$3,000 to \$20,000. Network adapter may be extra.	\$3,000 to \$10,000 but coming down fast.
Cost per page	Less than 1 cent.	Monochrome, \$0.02 to \$0.08; color, \$0.20 to \$1.20.	1 to 4 cents.	1 to 3 cents.	Thermal wax, solid-ink models, \$0.50 to \$1.50; thermal dye transfer units, \$2.00 to \$5.00.
Output quality	24-pin output, adequate. No match for ink jet, let alone laser output.	Almost but not quite laser quality. Special paper improves high-res images.	Excellent, especially from 600-dpi units.	Excellent, especially from 600-dpi units.	Thermal dye transfer output matches photos in terms of quality. Thermal wax and solid-ink output is vibrant but grainy.
Color	Some units have color-ribbon options, but output is acceptable only for highlight colors.	Majority of units are color-capable. Good for printing business charts. The best do a fair job of reproducing photos on special stock.	Three vendors now offer color units priced at \$7,000 to \$10,000.	The first color printers are easily networkable but don't have the speed to be heavy-duty network printers.	Standard.
Media	Perforated or cut sheets.	Cut sheets, transparencies, labels, envelopes.	Cut sheets, transparencies, labels, envelopes.	Cut sheets, transparencies, labels, envelopes.	Transparencies, coated stock, some units can use plain paper.
Options	Cut-sheet feeder, tractor feed, color-upgrade kit.	Three-color upgrade available for some monochrome units.	Second paper bin, envelope feeder, PostScript capability, network adapter.	Second paper bin, envelope feeder, duplexer, PostScript capability, network adapter.	Internal network adapters.
Size, noise, energy efficiency	Narrow-carriage units fit easily on desktops. Buzzy or raspy (and using quiet mode cuts speed). Naturally energy-efficient.	Small (except HP models with horizontal paper trays) and nearly silent. Most use energy-efficient technology.	4- to 6-ppm units have footprints a little bigger than a sheet of paper. 8- to 12-ppm units are bulkier. Quiet except when feeding paper. Many meet Energy Star specifications (no more than 30 watts at rest, 4.5 watts for color lasers).	Need separate table or stand (units are too big for desktops). Relatively quiet except when feeding paper. Some meet Energy Star requirements (no more than 45 watts at rest) but can draw 1,000 watts printing.	Still bulky, can overwhelm small offices. High-pitched noises when printing may be disconcerting. Relatively low power consumption.
Outlook	The 9-pin personal market is dead, 24-pin fading. Okay for low-cost or forms printing. Competition from fast ink jets and lasers for forms printing.	As prices continue to fall, quality increases. Higher-end models compete with 4- to 6-ppm lasers.	The speed of entry-level units climbs to 6 ppm. More sub-\$500 600-dpi models coming. Interest in 8-ppm models and PostScript fades.	Entry level, 16 ppm. Expect more high-speed multifunction peripherals—plus easier setup and management.	More price cuts. Thermal wax transfer, solid-ink output could approach photo quality. Expect challenges from high-end ink jets.

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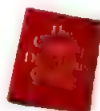
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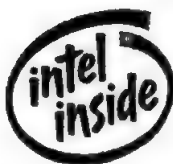
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ta, yellow, and black; it's called CMYK in the printing industry. A four-color model lets you print black text with black ink; it also gives added vibrancy to color. Three-color printers, by contrast, use just cyan, magenta, and yellow. Colors tend to be less deep and black text and objects (printed using a composite of the three colors) tend to have a dull, greenish tinge. The three-color models do let you substitute a single black cartridge when you're printing text-only documents.

Three-color ink jets are okay if your printing tasks fall into all-color jobs (overhead transparencies, flip charts) and all-monochrome jobs (memos). If you want to mix text and color graphics, spend the extra money for the four-color printer. Some monochrome-only ink jet printers can be upgraded to three-color operation with a color-upgrade kit, but three-color printers can't be upgraded to four-color.

HP, Canon (along with Apple, using Canon components), and Epson are the major ink jet vendors, and they are immensely protective of their market share. HP notes with pride that its ink jet printer division is a \$3-billion-a-year business—that's *billion* as in annual federal-deficit billion. And we're likely to see one more major player next year with Panasonic's belated arrival.

In addition to these standard printers, there are a number of specialty ink jets. Epson and Canon, for example, market tabloid-size printers. HP's DeskJet 1200C and 1200C/PS match laser printers on speed and deliver excellent color to boot. Several vendors offer stylish portable printers that make great

The U.S. Printer Market

Dot matrix sales fade; ink jet sales skyrocket; laser sales continue to grow.

U.S. PRINTER SALES, 1993 TO 1995*

Units shipped	1993	1994*	1995*
Impact	4,620,000	3,426,000	2,422,000
Ink jet	3,290,000	4,613,000	5,857,000
Laser	3,031,000	3,397,000	3,661,000
Other	104,000	117,000	69,000
Total sales	11,045,000	11,523,000	12,009,000

* Projected

Source: BIS Strategic Decisions.

LEADING PRINTER MANUFACTURERS

	Impact	Ink jet	Laser
1	Epson	Hewlett-Packard	Hewlett-Packard
2	Panasonic	Canon	Apple
3	Okidata	Apple	Okidata
4	Citizen	Epson	Epson
5	Star Micronics	Lexmark	Lexmark
6	Lexmark	Brother	Panasonic
7	Apple	Texas Instruments	NEC
8	Digital	Xerox	Texas Instruments
9	NEC	Eastman Kodak	Brother
10	Texas Instruments	Digital	Digital

Source: BIS Strategic Decisions (based on 1993 unit sales).

short-memo printers when used in the office (for more information, see "Portable Printers: No Desk Necessary," *PC Magazine*, August 1994).

Evolutionary changes include the continual reduction of printing costs (as little as 2 cents a page in some cases), higher resolution, and better color fidelity. The best ink jets, printing on good coated stock, now produce color output with passable flesh tones—passable meaning you won't be embarrassed but you also won't mistake it for a photograph.

TRENDS: AFFORDABLE LASERS

The second major trend is the continual price reduction for laser printers. About five years ago it became apparent that laser printers might reach a sub-\$1,000 selling price, but virtually no one thought

it possible that we would see a \$500 laser. In fact, Brother just brought out a 6-ppm printer, the HL-630, with a street price of about \$400. C-Tech's C. Itoh CI-44 Little Laser and Panasonic's SideWriter KX-P4400 also come in at about \$400. Vendors do have to make trade-offs to reach sub-\$500 selling prices. You may, for instance, wind up with only 512K of memory, usually not enough to image a large graphics file. Unless you print only a handful of pages each week, cost of supplies is a factor, too, and the sheer volume of the major sellers (HP, Apple, Okidata, Epson, Lexmark) means you will find their replacement toner cartridges competitively priced. At the high end of the low end, the standard of comparison remains the now-aging HP LaserJet 4L, which continues to sell everywhere for about \$630.

Laser printer prices are effectively coming down even more because of the dominance of TrueType, Microsoft's scalable font technology built into Windows. For most users, TrueType is a good-enough solution. Adobe PostScript is better and a must-have for graphic artists and desktop publishers, but it costs \$200 to \$500 more than a PCL (LaserJet-compatible) printer that uses TrueType.

COLOR LASERS

QMS has had a color laser printer out for a year now, and laser-printer giant HP may legitimize that market with its new \$7,295, 300-dpi HP Color LaserJet. We did find that the more expensive competitors, the Xerox 4900 Color Laser Printer and the second-generation QMS magicolor, benefited from higher-resolution print engines. In fact, Xerox's print quality is competitive with thermal wax transfer printers. If you want to tint the background of a spreadsheet or embed a color chart, the HP is fine. Perhaps best of all, from all these color lasers you get good results from photocopy paper (whereas ink jet printers demand expensive coated stock for the best quality). When you reproduce color

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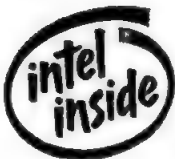


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How We Tested the Printers

PC Magazine Labs subjected this year's group of 109 printers to a battery of more than a dozen tests measuring text and graphics speed, compatibility, print quality, color fidelity, and power consumption.

TEST ENVIRONMENT

PC Labs ran all tests on a Compaq Deskpro 486/33M with 8MB of RAM and a 310MB hard disk. For our Windows applications tests, we installed Microsoft Windows 3.1 in its default configuration. To get the most consistent results, we turned off virtual memory and bypassed the Print Manager. We ran all print-quality tests at each unit's highest resolution, with any resolution-enhancement or smoothing feature turned on.

NETWORK SPEED TEST

This measures a network printer's ability to handle multiple simultaneous print

jobs. We sent each printer an alternating load of 725K PCL and 3.7MB PostScript print jobs across a network, sending a total of three jobs each. We performed this test on departmental lasers only.

POWER CONSUMPTION TEST

We measured power consumption when printing, when idle, and in power-saver sleep mode for all laser and high-end color printers. The EPA's Energy Star program calls for laser printers to use less than 30 watts in sleep mode (or less than 45 watts for color printers and printers faster than 15 ppm).



Harvard Graphics Color Quality Test

This test measures each printer's ability to reproduce a business chart. We created the chart in Software Publishing Corp.'s Harvard Graphics for Windows. We ran it only on color printers.

How to Read the Printer Guides

The printer guides summarize each printer's features and key test results. The guides appear in every section except for the dot matrix section. A band across the top of each guide includes the printer name and list price. Editors' Choice hon-

orees have blue bands; all other products have red ones. We ran our graphics tests at each printer's highest resolution. For all performance tests, higher numbers indicate faster printing performance. Below is a sample printer guide.

Test results are reported in pages per minute (ppm), graphics pages per minute (gppm), characters per second (cps), or lines per minute (lpm)—depending on the test and printer technology. We report the results of our speed tests for laser printers at 300 dpi to simplify comparisons among printers. Speed results for ink jet and dot matrix printers are reported for both draft and letter-quality modes. For dual-mode laser printers, we report results in both PCL and PostScript emulations.

HP LaserJet 4Si MX
\$5,299
17-ppm laser printer (Canon LBP-NX engine) with 600- by 600-dpi output, Adobe PostScript Level 2, enhanced PCL 5

PCL Text Speed: 14.6 ppm
PCL Graphics Speed: 3.5 gppm
PS Text Speed: 14.2 ppm
PS Graphics Speed: 1.6 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 12.2 ppm
Lotus 1-2-3 for Windows: 4.0 gppm
CorelDRAW: 2.1 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 11.1 ppm
Lotus 1-2-3 for Windows: 2.7 gppm
CorelDRAW: 1.8 gppm

Remember that ti

Reme

Line art shows how well each printer reproduces lines and curves. The samples are reproduced at the same size that they were created. Look especially for no jaggedness on the curve.

Text output shows the quality of a serif font reproduced at the same size and enlarged five times.

Gray-scale or color output comprises a gradation of shades of gray or six colors (for color printers).

Graphics output shows how well each printer reproduces photographs, or halftones. The samples are reproduced at the same size they were created.

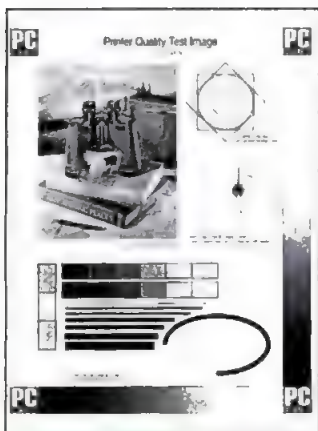
photos, though, you won't mistake the output for pages from *National Geographic*. The most important point about color laser printers is that they are not specialty devices to be cranked up only for high-impact reports. They are intended to be daily-use monochrome laser printers capable of printing color as needed.

SEGMENTED LASER MARKET

The previous mainstay of the laser printer market, the 8-ppm LaserJet or LaserJet clone, is moribund. Buyers today want less or more: either cheaper, sub-\$1,000 personal printers that today run at 4, 5, or 6 ppm or networkable printers running at more than 12 ppm. HP's best-selling 8-ppm LaserJet 4 has been recast

as the 12-ppm LaserJet 4 Plus, still selling for about \$1,400. Over time, you can expect engine speeds to creep up on personal laser printers, too. Sharp, for instance, sells the competent 8-ppm, 300-dpi JX-9400H for about \$600, roughly the same as HP's price for its 4-ppm LaserJet 4L.

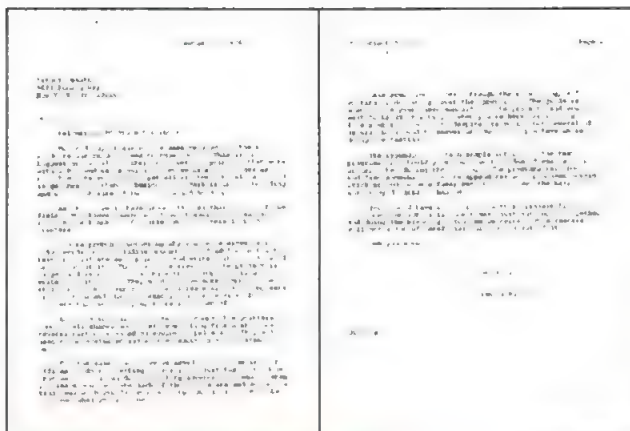
Among networkable laser printers,



Graphics Speed and CorelDRAW Tests

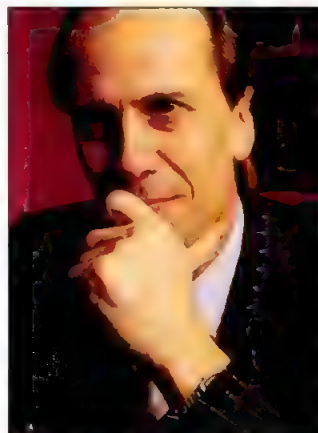
We used this page of graphics for both our Graphics Speed and CorelDRAW tests. For the CorelDRAW test, we timed each printer as it produced this page from the application using the supplied Microsoft Windows driver. For the Graphics Speed test, we timed each printer as it produced the page from a print file sent directly from DOS.

This page helped us determine both compatibility and output quality. We looked at each printer's abilities to reproduce clear details in the halftone image and consistent line weights in the hairline rules rotated in 10-degree increments. We also looked at edge quality in the star/square image and horizontal and vertical gray scales.



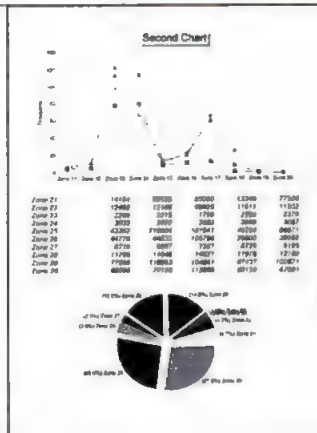
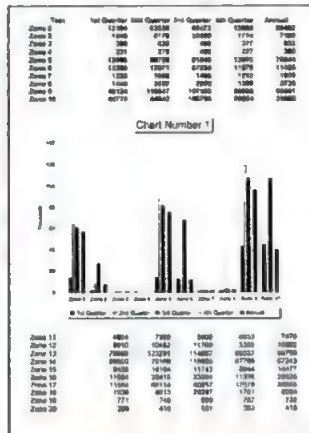
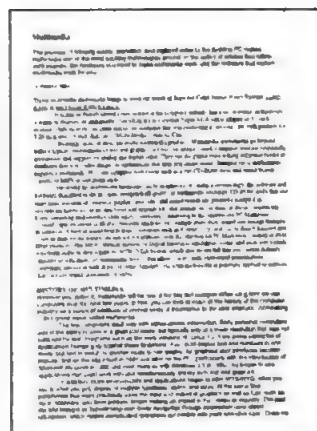
Text Speed and Word for Windows Tests

For the Text Speed test, we used a two-page, single-font business letter printed from DOS. The Word for Windows test document is a ten-page multifont test that measures text-printing speed under Windows. (The first page is shown.) It uses multiple Arial and Times New Roman fonts. In order to reduce the performance lag induced in producing the first page with laser printers, we printed the Text Speed test's business letter ten times and the Word for Windows document five times. We did not run these tests on high-end color printers.



Photoshop Color Quality Test

This test measures each printer's ability to render faithfully a color photograph, or halftone. We prepared the scanned image in Adobe Photoshop and ran it only on color laser, ink jet, and high-end color printers.



Lotus 1-2-3 for Windows Test

The Lotus 1-2-3 for Windows speed test shows printer performance when printing typical business graphics from within Windows. This two-page document, created in Lotus 1-2-3 for Windows, comprises three spreadsheet ranges and three charts.

there are 8- to 12-ppm devices that get hooked to the network, and then there are truly high-speed printers (16 ppm and up) designed with both the user and the network administrator in mind. Hewlett-Packard and QMS have always excelled in this market. Compaq used to do well in this segment, but it couldn't stand the competition from HP and abandoned the

laser printer market this year.

We believe every office should have at least one tabloid-size printer accessible to users for big spreadsheets or flipcharts. Since HP until recently ignored this market, you may want to look at the 32-ppm QMS 3225 Print System or the 20-ppm Xerox 4520mp, built around the same B-size Fuji-Xerox engine family

used on the erstwhile Compaq Page-marq printers.

If there's an award for comeback of the year, it belongs to Xerox, the company that stumbled its way through two decades of the computer revolution. This year Xerox has three sensational printers: one of the best tabloid laser printers; a color laser with excellent output; and an

ultra-heavy-duty, photocopier-like, 300-dpi printer, the 4220.

REVIEW CRITERIA

Each fall, *PC Magazine* and PC Magazine Labs devote an issue to hands-on testing of all new printers that reached the market in the past year. To be reviewed here, printers had to be new (not previously reviewed) and shipping as of

September 1994. Printers announced, but not shipping, by our test deadlines are cited in the introduction to each review section.

To reflect the changing marketplace, here's how we organized our review sections this year:

- Thirty-seven personal and workgroup laser printers. Throughout this issue, when we say *laser printers*, we mean any

page-printing technology, whether laser, LED, or other "laser-like" technology. *Personal printers* are the low-cost, 4- to 6-ppm lasers destined for standalone (non-networked) use on individual desktops. *Workgroup printers* are faster printers, typically with speeds of 8 to 12 ppm, that can be used as standalone printers or networked for use with a small workgroup. If the vendor sells an integrated (built-in) network attachment, we requested that as well and ran an abbreviated set of our network tests.

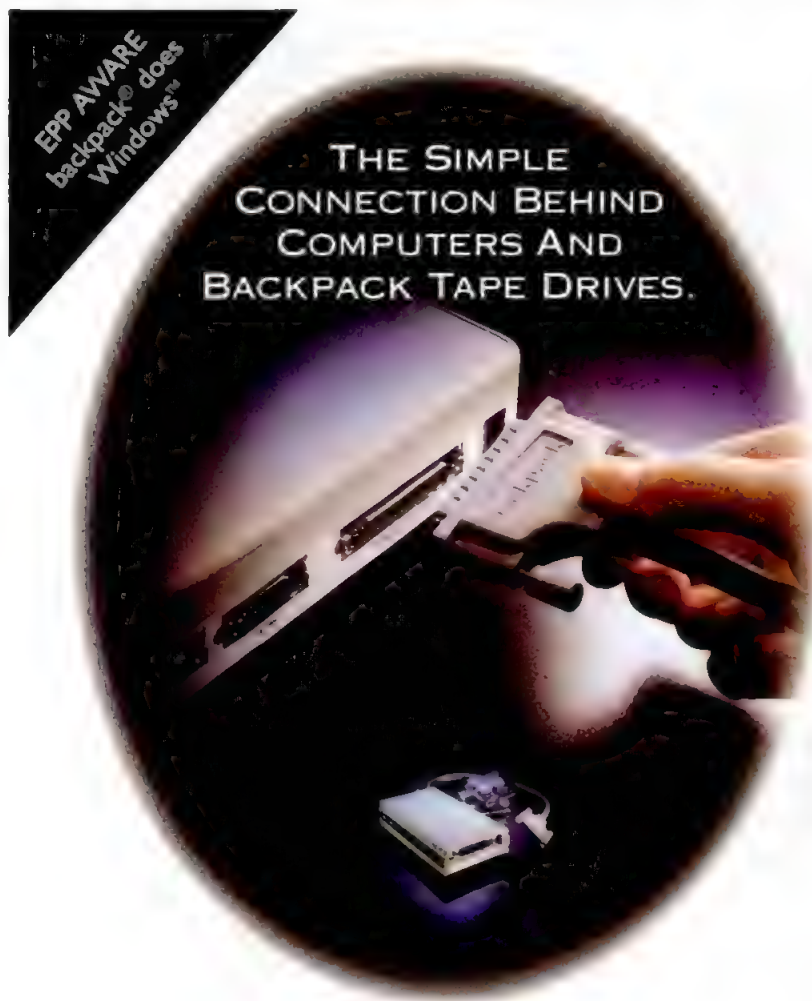
- Thirteen departmental laser printers. These are laser printers with engine speeds above 12 ppm that were designed from the outset as network printers. They have integrated network attachments and considerable attention has been paid to their set-up and remote administration. Nine are B-size (11- by 17-inch) printers. Many offer a duplexing option (printing on both sides of a page), which is an effective way to reduce printing costs.

- Nineteen ink jet printers. A year ago, color was an interesting attribute of one or two ink jet printers. Now the majority have color capability.

- Eleven high-end color printers. These are dedicated color printers using specialized technologies: thermal wax transfer, thermal dye transfer, and solid ink. They are aimed at corporations that need at least one printer to produce high-quality color graphics in-house, as well as specialized markets such as prepress and engineering shops.

- Twenty-nine dot matrix and line printers. Dot matrix really comprises two polar-opposite subgroups: low-cost (often sub-\$200) personal dot matrix printers and heavy-duty, \$500-plus printers of mailing labels and multipart business forms.

As in years past, reviews are arranged alphabetically by vendor name. When a vendor offers two or more printers in a category, they appear together in a single review. In cases where two or more vendors market essentially the same product (for instance, the Lexmark IBM Laser-Printer 4039 12R Plus is also sold by Unisys as the AP9312 Plus), PC Labs tests the products individually, and we publish a joint review highlighting similarities and differences. □



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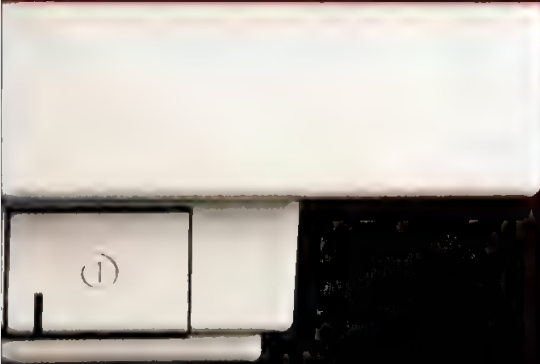
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CIRCLE 056 ON READER SERVICE CARD

Affordable and Feature-Rich

The sub-\$400 personal laser printer has arrived, and midprice laser printers offer more features and better output than ever before.

By Alfred Poor

Laser is clearly the technology of choice for business printing. It's quiet, clean, and cost-effective, and its monochrome output is the best of any existing desktop-printing technology. And the good news is that when it comes to price, resolution, network support, and even color, you now have more choices than ever before. Whether you need a budget-price desktop printer for letters, a 600-dot-per-inch PostScript printer for desktop publishing, or a fast, versatile laser to share with a workgroup, you'll find a laser printer in this section that fills the bill.

Last year we divided laser printer coverage into two sections: personal lasers, which we defined as having engine speeds of under 12 pages per minute; and network lasers, which we defined as having engine speeds of 12 ppm or higher. This year we recognize that many laser



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printers ranging in speed from 8 ppm to 12 ppm are shared by small workgroups, so we've added some network testing for those printers and divided laser coverage into two new sections: personal and workgroup lasers, with engine speeds up to and including 12 ppm, and departmental lasers, with engine speeds higher than 12 ppm.

Workgroup lasers tend to have engine speeds ranging from 8 ppm to 12 ppm and tend to be shared by 5 to 15 users. Many offer internal network connections and some remote management software. If we received a printer for which the vendor offered an optional network interface card, we connected the printer to our network and tested any network utilities that were included.

REVIEW CRITERIA

To be in this roundup, a printer had to print up to and including 12 ppm using laser or LED technology, had to have not been reviewed in any previous printer blockbuster, and had to be available in distribution channels by early September 1994. We also brought back the Editors' Choices from last year's printer issue—the Okidata OL400e, the TI microWriter PS23, the HP LaserJet 4L and 4P, and the TI microLaser Pro 600 PS23—to see how they would fare against this year's entries.

We received 37 printers from 16 vendors. The following printers did not ar-

rive in time for testing: Brother International Corp.'s Brother HL-645 (\$599) and Brother HL-655M (\$699); CalComp's CCL600ES (exact price not available, estimated at \$5,000); C-Tech Electronics' C. Itoh ProWriter CI-88 (\$1,499); GCC Technologies' SelectPress 1200 (\$7,499), Elite 600 (\$1,479), and Elite 600et (\$1,869); LaserMaster Technologies' WinPrinter 1000 (\$1,095) and WinPrinter 600XL (\$2,479); Lexmark International's new family of 1,200-dpi network lasers (no prices available) with Adobe PostScript Level 2 and PCL 5—the Optra R (12 ppm) and the Optra L (12 ppm) units; and NEC's Silentwriter SuperScript 660 (\$599) and Silentwriter SuperScript 660i (\$799).

We ran each printer through our Text Speed and Graphics Speed tests, as well as our Windows applications tests, which gauge a printer's real-world performance running popular Windows applications.

The leader in terms of raw speed was the 12-ppm TI microLaser Power Pro, which came in first on our Text Speed test (with a score of 12.1 ppm) and on our Graphics Speed test in both PCL and PostScript modes (with scores of 4.4 graphics pages per minute and 1.7 gppm, respectively). In Word for Windows, the HP LaserJet 4M Plus led the pack with a score of 10 ppm in PCL and a score of 9.8 ppm in PostScript. On our CorelDRAW

test, the QMS 1060 Print System led the pack, with a score of 2.0 gppm in PCL and 1.6 gppm in PostScript.

EXTRAS NOW STANDARD

The major trend in personal and workgroup lasers continues to be more features for less money. The HP LaserJet 4 Plus raised the bar this year by offering 12-ppm performance at a price of \$1,839—the same price as its predecessor, the HP LaserJet 4, which printed at only 8 ppm. For entry-level users, we found three laser printers—the Brother HL-630 (Editors' Choice winner), the C. Itoh CI-44 Little Laser, and the Panasonic SideWriter KX-P4400—that have spectacularly low street prices of \$399, \$100 less than the least expensive laser we reviewed last year (the KX-P4400 reaches \$399 only after a \$50 rebate, available until December 31, 1994).

Perhaps most impressive is the fact that even though prices continue to fall, what used to be extras are now standard features. Of the 37 printers in this roundup, 29 offer PCL 5 support or better, at prices as low as \$779 (for the DEClaser 1800). And 21 come standard with PostScript, 18 of them with the more capable and faster PostScript Level 2. While 13 printers offer only 300-dpi resolution, 24 offer 600-dpi resolution or better. The TI microLaser 600 offers 600-dpi PostScript Level 2 at a street price of only \$899.

You'll also find other standard features that used to be less common. Simultaneously active ports, bidirectional parallel ports, and automatic emulation switching make it easier than ever to set up a printer and get print jobs done quickly; all are included with the majority of these printers. All but 7 printers have controllers driven by RISC processors for added graphics performance, including the \$489 (street price) Okidata OL400e. And enhanced-resolution tricks that can smooth the rough edges from line art have become the norm, found in 25 of these 37 printers.

Another important change is that 28 of the printers in this group met the Environmental Protection Agency's standards for Energy Star compliance, compared with 13 out of 37 for last year; that means they have a sleep mode that drops

power consumption to less than 30 watts (less than 45 watts for color lasers). The C. Itoh CI-44 Little Laser, Canon LBP-430, HP LaserJet 4L, HP LaserJet 4P, and IBM LaserPrinter 4037 5E have extremely aggressive sleep modes, dropping power consumption to less than 10 watts—about the amount consumed by a typical night light. These printers are meant to be left on all the time; the Canon LBP-430 and HP LaserJet 4L don't even have power switches.



SHARING THE WEALTH

In recognition of the fact that the faster printers in this group are being pressed into workgroup service, manufacturers are paying more attention to how you hook up these printers to networks. Eighteen of these laser printers either come with or offer internal network interface cards as options, obviating the need to dedicate a PC as a print server.

The best workgroup printers, such as those from HP, Lexmark, and Xerox, have software that installs quickly and easily, configures NetWare to recognize the printer, and takes advantage of bidirectional communications so the printer can tell you when it has a paper jam or is out of toner, and so you can reconfigure the printer from your keyboard. At the other end of the spectrum, the DEClaser 5100 leaves you at the mercy of Novell's PCONSOLE for installation. While none of the printers in this section caused us serious installation problems, we have had experiences with network printers whose installation instructions are so arcane and whose installation procedures are so obtuse that they can confound a pair of network experts and take a full day or more to get running correctly.

DIFFERENT STROKES

Perhaps the biggest news in lasers is the advent of color. There are three printers in this new category: the HP Color LaserJet, QMS magicolor, and Xerox 4900 Color Laser Printer. The 10-ppm (2-ppm in color), 300-dpi, PCL-based HP Color LaserJet is the least expensive, with a price of \$7,295. Xerox's 12-ppm (3-ppm in color) 4900 offers 300-dpi PostScript for \$8,495, and 1,200-by-300-dpi color PostScript after a \$949 RAM upgrade. At the high end, the

Personal printers:

- Brother HL-630
- Sharp JX-9400H

Workgroup printers:

- Hewlett-Packard HP LaserJet 4 Plus
- Hewlett-Packard HP LaserJet 4M Plus

Prices of personal and workgroup printers have dropped, putting laser-quality output within reach of individuals who would have otherwise opted for ink jet or dot matrix printers, and allowing corporate buyers to install more shared units for small groups

of users. In this roundup of 37 printers, we didn't find a single one that we would not recommend.

The day of the sub-\$400 laser printer has arrived, and we particularly liked the brand-new Brother HL-630. Listing for \$499 and selling on the street for just \$399, the HL-630 offers everything a SOHO user could want: low price, reliable paper handling, decent speed (rated at 6 pages per minute), a small footprint, and sharp text output. Graphics printed by this 300-dot-per-inch unit tended to be too dark, but for individuals who want affordable laser-quality text, the HL-630 is a good choice. Another machine in this class—the Panasonic SideWriter KX-P4400—merits an honorable mention. The mini-tower design makes the Panasonic ideal where desk real estate is of primary concern, and you can find this unit for \$399 (after the \$50 mail-in rebate). Our one complaint: The unit choked on envelopes during testing.

Another personal laser, the Sharp JX-9400H, deserves Editors' Choice recognition. The 300-dpi JX-9400H doesn't offer a lot of features, such as resolution enhancement or PostScript printing, but this compact laser printer delivers 8-ppm speed for just \$549 (street price) and should satisfy most business users' needs.

As for the perennial sales leader, Hewlett-Packard offers the 300-dpi HP LaserJet 4L and the 600-dpi HP LaserJet 4P—still excellent printers

though not as price-competitive now as they were last year when we picked them as Editors' Choices.

For corporate workgroup environments where output quality is most important, look to the HP LaserJet 4 Plus (\$1,375, street price) and HP LaserJet 4M Plus (\$1,950, street price). The LaserJet 4 Plus is ideal for PCL environments, while the LaserJet 4M Plus includes Adobe PostScript Level 2, more memory, and built-in network cards. Both printers offer outstanding 600-dpi text and graphics output and are among the fastest workgroup units we tested. You also get HP's superb network installation and remote management utilities.

Color laser technology is still coming of age, and none of the three color units we examined stood out as a price/performance leader. The best color output was produced by the QMS magicolor, which delivers 600-by-600-dpi resolution and PostScript Level 2, but you'll have to spend \$9,999 on the printer and another \$1,000 on a RAM upgrade. Next in color quality was the Xerox 4900 Color LaserPrinter (\$7,995 street). A RAM upgrade (\$949) delivers dither-free 1,200-by-300-dpi printing, though per-page cost is notably higher than that of the other color laser printers. The HP Color LaserJet is the most affordable of the trio (\$7,295), but its 300-dpi, PCL-only output is suitable primarily for business users.

8-ppm (2-ppm in color) QMS magicolor gives you 300-dpi color for \$9,999, 600-dpi color after a \$1,299 RAM upgrade, in PCL or PostScript.

The HP's 300-dpi output lacks the quality of the higher resolution output offered by the other two printers, but it is perfectly acceptable for the average business user. The Xerox and QMS color lasers produce excellent output, rivaling or surpassing the best thermal wax transfer printers. And color lasers are faster (and often quieter) than thermal wax transfer printers. Per-page costs of color output vary considerably. At 5 percent of page coverage each for cyan, magenta, yellow, and black, the HP comes in at 10.7 cents, the QMS at 20 cents, and the Xerox at 25.4 cents per page.

In addition, there are five new printers designed specifically for Microsoft Windows users. These are called GDI printers, and they print directly from Windows' Graphics Device Interface—the graphics language Windows uses to provide output to the screen and other devices—skipping the usual translation to PostScript or PCL. Some GDI printers, such as the C. Itoh CI-44 Little Laser, come without a processor and place the workload on the computer system's CPU. Others, such as the Lexmark Winwriter 600, share the load with the system CPU. The Winwriter 600 is also

one of the first printers to incorporate Microsoft At Work (MAW) technology to provide software control of the printer from your PC. In most cases, you can use a GDI printer to print from a DOS application as long as you're printing from a DOS window under Windows. DOS output from the GDI-based C. Itoh CI-44 Little Laser, however, was of lower quality than Windows output.

And there is a new breed of GDI printers, represented here by the C. Itoh ProWriter CI-8Xtra, C. Itoh ProWriter CI-8Xtra+, and C. Itoh ProWriter CI-8XA, which rely on their own RISC processors but use GDI technology to create 600-dpi images. In PCL and PostScript these printers are limited to 300 dpi. GDI does not appear to provide an automatic competitive advantage, however, as GDI printers did not stand out in terms of price or performance.

Five printers offer duplexing—the ability to print on both sides of a sheet of paper without user intervention—as an option, making it easier and cheaper to print long reports. Within this group, only the HP Color LaserJet allows B-size (11- by 17-inch) printing, and only in monochrome mode.

Whatever your needs, laser printers are cheaper, better, and more feature-rich than ever before.

Apple Computer Inc.

● Apple LaserWriter Select 360

BY BILL DYSZEL

The Apple LaserWriter Select 360 provides an acceptable combination of speed (10 pages per minute), 600-dot-per-inch print quality (300 dpi in PCL 5), and a competitive price (\$1,599 list) for workgroup printing, although it does not accommodate an interface card for typical PC networks. Despite its Apple logo, the LaserWriter comes with a parallel port with bidirectional and ECP support and is compatible with DOS and Windows applications.

Ease of use has always been Apple's strong suit, and the LaserWriter is no exception. An easy-to-use Windows-based



Apple LaserWriter Select 360

HIGHLIGHTS

Personal/Workgroup Lasers

IN PERSONAL LASERS, the big news is lower prices. Prices are low enough that home and SOHO users who would have opted in the past for inexpensive ink jet printers can now trade up to laser quality. Three printers—the Brother HL-630, C. Itoh CI-44 Little Laser, and Panasonic SideWriter KX-P4400—can be found at street prices of around \$400.

WORKGROUP LASER PRINTERS are designed to be shared in a small department, usually among 5 to 15 users. With engine speeds of up to and including 12 pages per minute, these units offer network connectivity and, often, remote management utilities to ease the job of administration.

MORE FEATURES FOR LESS MONEY continues to be the trend. Of the 37 printers in this roundup, 29 offer PCL 5 emulation support; 21 offer PostScript support. Almost two-thirds of the units offer 600-dot-per-inch resolution in at least one emulation, while 25 provide some type of resolution-enhancement technology to improve output.

GDI PRINTERS are a niche offering that may appeal to some users. Designed primarily to print from Microsoft Windows applications, these machines print directly from Windows' Graphics Device Interface without translating a print job to PCL or PostScript. This can save some initial

expense (the printer often relies on your PC's processor instead of on an internal one) and provide you with better images (delivering 600-dpi resolution under Windows from a unit that otherwise offers only 300 dpi).

COLOR LASER TECHNOLOGY has arrived. With prices still above \$7,000, you won't see a color laser on every desktop anytime soon. But color laser is a viable alternative to traditional high-end, high-priced dedicated color technologies, especially for business users who need both color and monochrome output. In this roundup, we look at color laser units from Hewlett-Packard Co., QMS, and Xerox Corp.

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Resolution Game: *What's in a Dot?*

By Alfred Poor

As you read the reviews in this section and in the network laser section, you will find a wide range of claimed resolutions: 300 dots per inch, 300 by 600 dpi, 600 dpi, 1,200 by 1,200 dpi, 1,200 dpi, and others. What exactly is resolution, and how do different laser-printer vendors define their ratings?

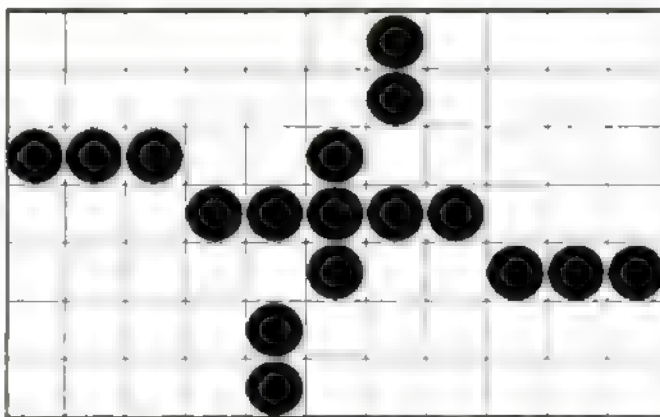
To understand resolution, it's necessary to understand how a printer places dots on the page. A diode laser projects its light against a spinning mirror, which flashes the light at a rotating drum. The drum is coated with a photosensitive layer that changes its electrical charge at the point where it is struck by the laser's light. Toner adheres electrostatically to the charged area of the drum and is then fused to the paper.

A printer's engine resolution is determined by two factors. First, the speed at which the mirror can spin and the speed at which the laser can turn on and off determine how many dots can be drawn in a single line across the drum. Second, the degree of rotation of the drum determines the number of scan lines that can be drawn for each inch of the drum's surface.

Most laser engines are designed to produce 300- by 300-dpi output (300 dots in a single line and 300 scan lines per inch) or 600- by 600-dpi output. Most laser printers today, however, use clever tricks to manipulate the size and placement of certain dots. By shortening the pulse of the laser beam, the amount of light hitting the drum can be reduced, resulting in a smaller area where the charge is altered sufficiently to attract toner; thus, a smaller dot. By causing the laser to fire slightly early or slightly late, the position of the dot can be altered horizontally.

A printer that skillfully manipulates dot size and position can fill in jagged steps between standard-size dots with

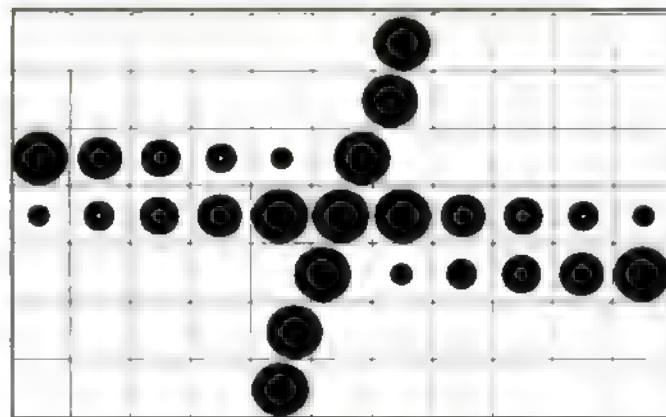
smaller dots. This reduces the jagged appearance of diagonal lines and curves used in text and line art, yielding output that can look almost as good as output from engines with resolutions that are two to five times as high. Hewlett-Packard Co. performs tricks like these with most printers in its LaserJet series and describes these units as offering 600 by 600 dpi with Resolution Enhancement Technology (RET).



Shown above is a graphical depiction of dots of toner forming two intersecting lines, one nearly vertical, the other nearly horizontal. The graphic on the right shows the output from a printer with enhanced resolution: The stair-step effect resulting from the bigger dots is filled in with smaller dots. Vertical dots have been repositioned slightly. The graphic on the left depicts the same lines without resolution enhancement.

must be able to hold its charge in sufficiently small areas to accept or reject the toner from the tiny areas required for high resolution. And the toner itself must be made of sufficiently fine particles so that they adhere to only those parts of the drum they are supposed to yet still transfer reliably to the sheet of paper as it passes the drum.

Manufacturers do not always specify these other aspects of their prod-



Some printers take this a step further; instead of filling in spaces between large dots with smaller dots, they actually manipulate the laser to address 1,200 horizontal dot positions with a 300- or 600-dpi engine. Xerox calls this feature addressability and claims 1,200- by 300-dpi resolution for its Xerox 4900 Color Laser Printer. Another common practice is slowing the drum's rotation speed so that the number of scan lines can be doubled vertically. This is a practice commonly used in printers that claim 1,200- by 1,200-dpi (also called simply 1,200 dpi) resolution.

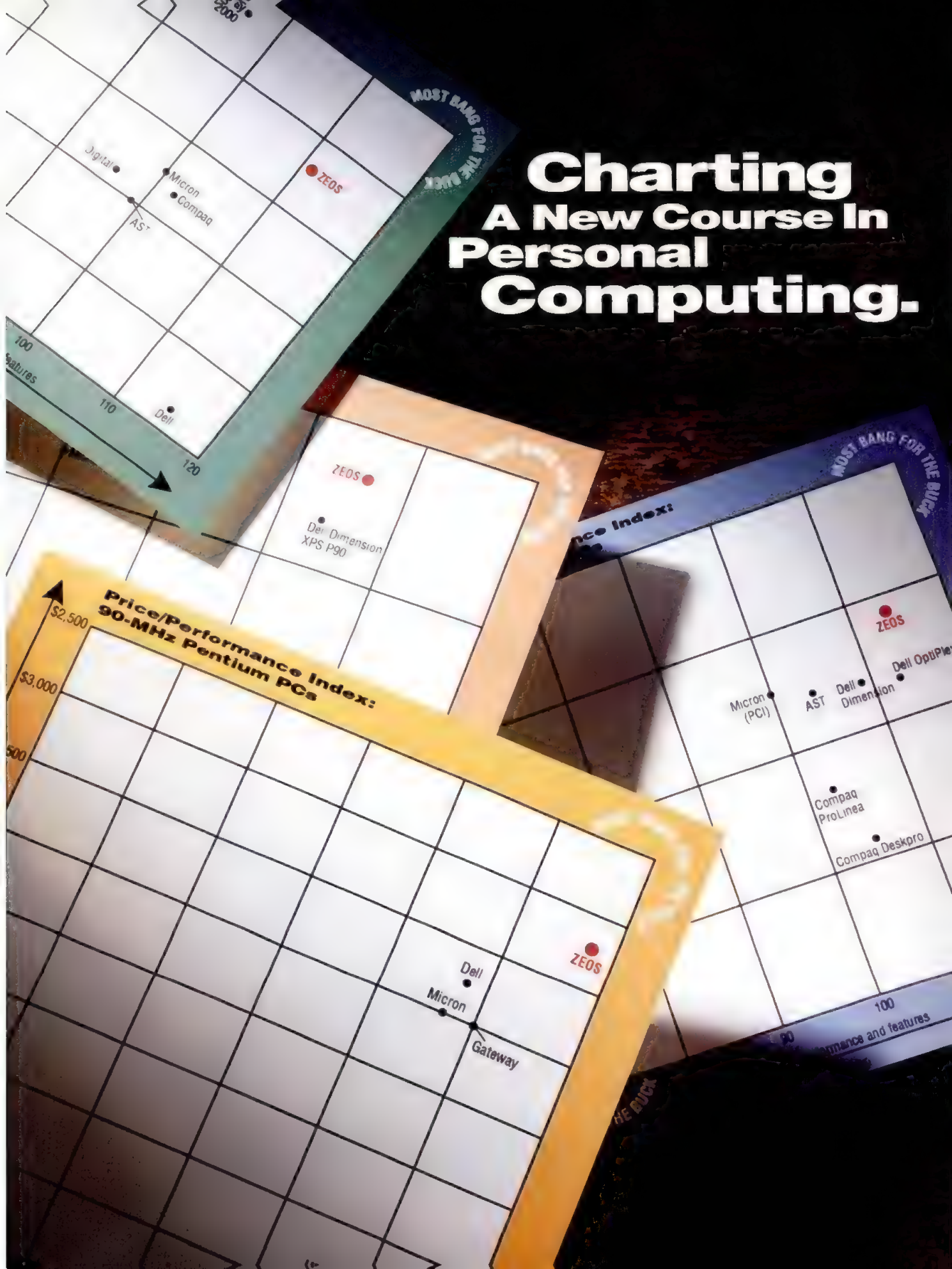
Don't assume, however, that a printer claiming 1,200-dpi resolution will produce output that is superior to that of a 600-dpi printer. The electronics in the controller must be able to handle more data per second in order to pulse the laser faster. The drum

ucts' capabilities. You will often see ratings that cite "effective resolution," which typically includes the effects of some resolution-enhancement techniques. Note also that standard enhancement techniques often have a detrimental effect on images with different levels of gray tones, such as scanned photographs.

The engine resolution is a more reliable indication of how many dots per inch the printer can produce in the horizontal and vertical dimensions, and resolution-enhancement techniques will then improve on those specifications.

Ultimately, the best means of identifying effective resolution remains the user's own eye—though a loupe or other magnifier can be a valuable aid in the process. When it comes to laser printer resolution, seeing is believing. □

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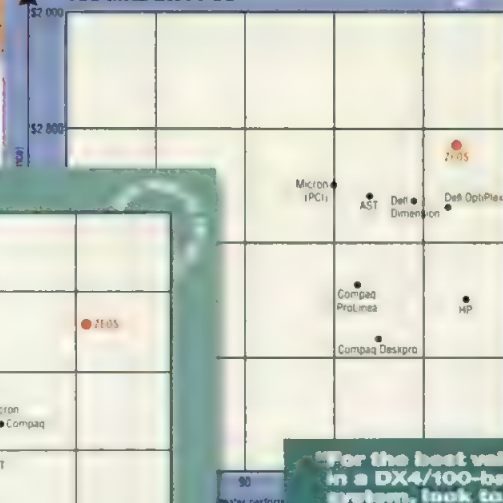
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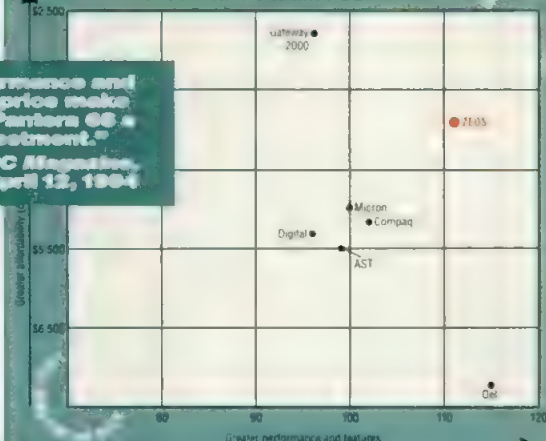
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Standard With Every ZEOS Panthera System: ➤ Genuine Intel Processor, ZIF socket for easy upgrading. ➤ PCI local bus color graphics card upgradable to 2MB. ➤ Two high-speed serial ports and one enhanced parallel port on the motherboard. ➤ Three PCI & 5 ISA slots. ➤ Socket for optional on-board Fast SCSI-2. ➤ Flash BIOS. ➤ 200 watt power supply with built-in surge suppressor. Switchable between 115/230V. ➤ ZEOS 101-key space-saving keyboard. ➤ FCC Certified Class B; UL Listed. ➤ ZEOS Customer Satisfaction Package.	➤ 4MB RAM ➤ 214MB local bus IDE hard drive with 32K cache ➤ 3.5" 1.44MB floppy disk drive ➤ 64-bit Windows-accelerated PCI local bus SVGA color graphics card with 1MB RAM ➤ ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse	➤ 8MB RAM ➤ 528MB local bus IDE hard drive with 256K cache ➤ 2X CD-ROM drive, 3.5" 1.44MB FDD ➤ 64-bit Windows-accelerated PCI local bus SVGA color graphics card with 1MB RAM ➤ ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse	➤ 16MB RAM ➤ 720MB local bus IDE hard drive with 128K cache ➤ 2X CD-ROM drive, 3.5" 1.44MB FDD ➤ 64-bit Windows-accelerated PCI local bus SVGA color graphics card with 1MB RAM ➤ ZEOS 15" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse ➤ Choice of Lotus Windows application	➤ 24MB RAM ➤ 1GB local bus IDE hard drive with 256K cache ➤ 2X CD-ROM drive, 3.5" 1.44MB FDD ➤ 64-bit Windows-accelerated PCI local bus SVGA color graphics card with 1MB RAM ➤ ZEOS 15" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse ➤ Choice of Lotus Windows application
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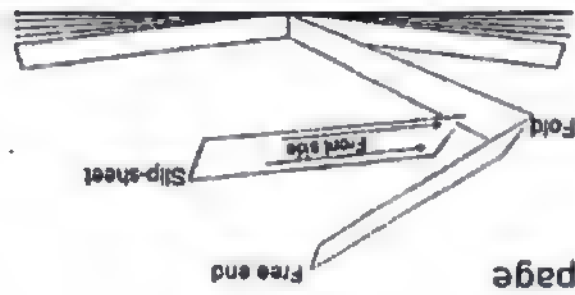
2. Insert this sheet with

1. Front side touching the free page

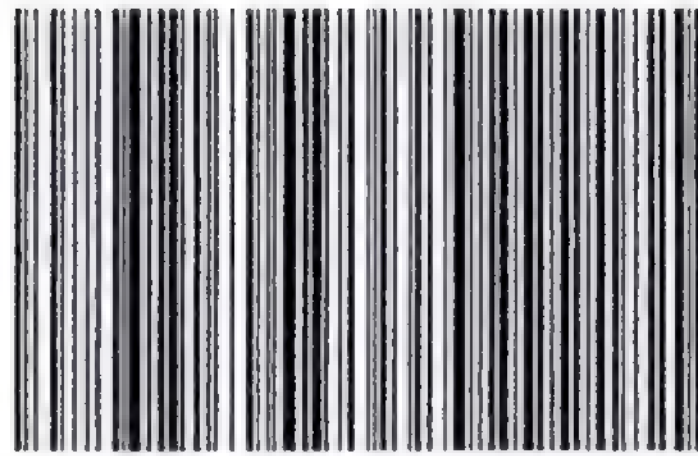
2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



Inverted Foldout slip-sheet



GbsSlipSheet-001



Foldout slip-sheet

Folded edge of the page

1. Open the foldout page

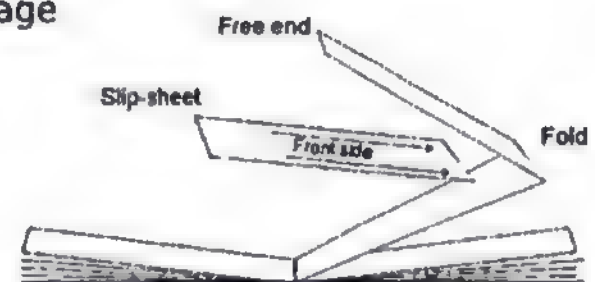
2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

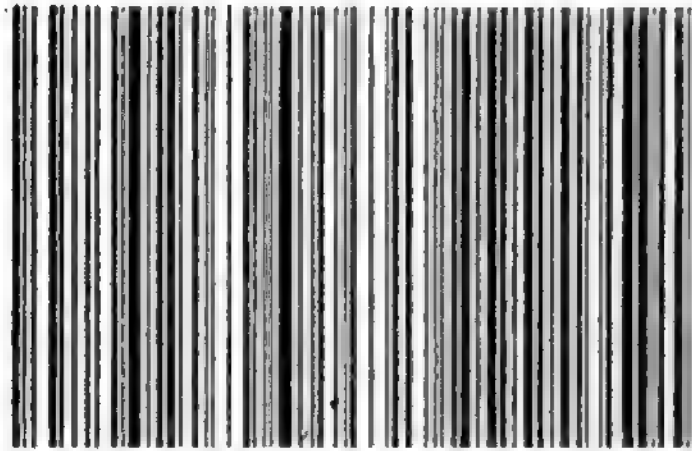
3. Slice the folded edge

4. Close the page and slip-sheet



1. Follow instructions on the other side

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GbsSlipBack-0018

Back

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Pentium-60
August 1994



DX4-100
October 1994
November 1994

Pentium-66
June 1994
July 1994
August 1994
September 1994

Pentium-60
August 1994
September 1994
October 1994
November 1994



Pentium-66
June 1994

Pentium-90
August 1994



Time after time, the ZEOS Pantera has been tested against the competition, repeatedly beating all others hands down. In *PC Magazine's* price and performance comparisons of technologically-advanced systems from primary computer companies, ZEOS is the unbeatable value.

Unmatched in its success, the Pantera is earning award after award—month after month. To date, the Pantera has received an unparalleled 22 top honors from leading industry publications! Experts agree that the ZEOS Pantera provides you with the biggest bang for your buck.

"The ZEOS Pantera 90 is the ultimate Power Desktop. It's lightning fast, beautifully configured, and priced right. That's what power Best Buy is all about," said *PC World*.

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PC World said the Pentium-66 and Pentium-90 Pantera PCs were "the fastest system(s) ever tested." *PC World* also awarded the Pantera DX4-100 a Power Best Buy in October after it outperformed all other DX4 machines, *and* was as fast as many Pentium-90 PCs!

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The Pantera is a first-rate example of ZEOS' commitment to provide you with an excellent value on an award-winning machine that will increase your productivity. With all the extras, options, and 100% compatibility with all major operating systems, you can't go wrong.



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Pentium-60 \$2145

Package #2:

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- PCI local bus SVGA video
- SVGA color monitor
- MS-DOS, Windows for Workgroups, Microsoft Mouse



486DX2-66 \$2295

Pentium-60 \$2595

Top Gun:

The above system modified to include:

- 256K SRAM cache
- Diamond Stealth 64/PCI local bus graphics card with 2MB VRAM
- 15" SVGA color monitor upgrade
- 14.4/14.4 send/receive fax modem
- Choice of Lotus Windows application



DX4-100 \$2745

Editors' 100:

- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64/PCI local bus graphics card with 2MB VRAM
- 14" SVGA color monitor
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus Windows application



Pentium-66 \$2895
Pentium-90 \$3045

Editors' Choice:

The above system modified to include:

- 15" SVGA color monitor upgrade
- 10-bay vertical case



Pentium-66 \$3418
Pentium-90 \$3568

Best MM:

- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" 1.44MB FDD
- 16-bit sound card, stereo speakers
- Diamond Stealth 64/PCI local bus graphics card with 2MB VRAM
- 17" SVGA color monitor
- 10-bay vertical case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus Windows application

Pentium-90 \$4295

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486SL-33 \$1995

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- Internal 96/24 send/receive fax modem
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- Extra battery
- External charging stand
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DX4-100 \$3095

Package #3:

- 8MB RAM
- 350MB IDE hard drive
- External 3.5" 1.44MB floppy drive
- STN color VGA 7.8" display
- Custom carrying case
- Extra battery
- MS-DOS, Windows for Workgroups
- Lotus Organizer
- 7.8" x 10.2" x 1.7", 3.9 lbs.

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CIRCLE 155 ON READER SERVICE CARD.

utility installed along with the printer driver allows the user to configure all features including the 250-sheet paper tray and Energy Star-compliant power-saver function. No comparable utility is available for DOS.

The LaserWriter has no front control panel—not even a button to hit in case of a printer jam. No jams occurred during testing, however, and automatic emulation and port switching worked flawlessly.

In 300-dpi PostScript, this unit produced text at 9.4 ppm—close to its rated speed—but performance in PCL 5 dropped to 7.2 ppm. PostScript graphics scores under DOS and Windows were slightly below average, with 0.8 graphics pages per minute on our Graphics Speed test (600 dpi) and 1 gppm on our CorelDRAW test (600 dpi). PostScript images were bold and well detailed. The grays showed little banding, and diagonal hairlines showed only slight stair-stepping. Text characters were dark and well defined, though the bottom of some very fine text did drop out.

The LaserWriter comes with 7MB of RAM (expandable to 16MB) and offers an optional PostScript fax card (\$300). **►Apple LaserWriter Select 360.** List price: \$1,599; 250-sheet feeder/cassette, \$149; 500-sheet feeder/cassette, \$299; 30-envelope cassette, \$89; 250-sheet letter- or legal-size paper cassette, \$79; PostScript fax card, \$300. Apple Computer Inc., 1 Infinite Loop, Cupertino, CA 95014; 800-446-3000, 408-996-1010; fax, 408-974-9974.

Circle 467 on reader service card

Brother International Corp.



EDITORS' CHOICE Brother HL-630

BY MARGARET PIEMONTE

The \$400 laser printer is here. Brother International Corp.'s 6-page-per-minute Brother HL-630, an Editors' Choice selection, is the perfect choice for individual and small office/home office users who need 300-dot-per-inch laser printing at a low cost. Brother International says the

printer's street price will be \$399, its list price \$499.

Despite the low price and minimal standard memory (512K), the HL-630 scored well on graphics tests, with a speed of 2.6 graphics pages per minute on our Graphics Speed test and 1.8 gppm on our CorelDRAW test. The graphics output did have some dark, unfocused images,

and gray-scale bars lacked distinction among the gray shades. Text printing was clear and sharp, and it seemed to be the printer's strong point.

Installing the 17,000-page drum and the 3,000-page toner was a little cumbersome, but the use of two separate pieces

reduces replacement costs. The 200-sheet, multipurpose sheet feeder (also slightly tricky to install) handles up to and including legal size, No. 10 envelopes, or heavy card stock. The feeder gets installed in the top of the printer to create a straight paper path, thus minimizing misfeeds and jams, and eliminating annoying paper curls. Envelopes fed through and printed with no problems during testing. The 13- by 14-inch footprint allows the printer to fit in congested areas, but you'll need another 5 inches to open the front output tray.

The HL-630 comes with a Windows driver that gives you the option to install any of the 24 bitmapped fonts or 21 TrueType-compatible fonts. The printer allows you to reprint the last page printed by hitting front-panel buttons.

The HL-600 series includes two higher-end 300-dpi printers that weren't shipping by our deadline: the HL-645 with

1MB of RAM and the PC- and Mac-compatible HL-655M with 2MB of RAM. Both include BookMaker Corp.'s Click-book software for producing handy booklets, in addition to a sample packet of various specialty papers. Expected selling prices are \$499 and \$599, respectively.

► **Brother HL-630.** List price: \$499. 1MB RAM upgrade, \$129; 1.5MB RAM upgrade, \$189.95; drum, \$189.95; toner, \$35.95. Brother International Corp., 200 Cottontail Lane, Somerset, NJ 08875-6714; 800-276-7746, 908-356-8880; fax, 714-859-2272.

Circle 468 on reader service card

Canon Computer Systems Inc.

• Canon LBP-430 • Canon LBP-860

BY ALFRED POOR

The buzzword is SOHO (small office/home office); the 4-page-per-minute, 300-dot-per-inch Canon LBP-430 (\$799 list, \$575 street) and 8-ppm, 600-dpi Canon LBP-860 (\$1,839 list, \$1,250 street) aim squarely at this target market. Both deliver quality performance in an easy-to-use package, but neither Canon unit offers the price/performance ratio to stand out in its respective crowd.

Dependability has been the hallmark of Canon laser-printer engines, and these two models stick to the previously successful formula of one-piece toner/developer/drum cartridges, making the replacement of consumables as easy as possible.

The most striking feature of the LBP-430 is the simplicity of its design. There's not even a power switch; the Energy Star-compliant design draws so little power in idle mode (powering down to just 4 watts) that there is no need to turn the printer off. The LBP-430's windowless control panel consists of a single button that controls a host of functions de-



Brother HL-630



Canon LBP-430

World-class overheads. Up to 600 x 300 dpi. Up to 2 pages per minute! Dual tray option switches from paper to transparencies by desktop command. Smart!

High impact color images on glossy covers. Info rich color on plain pages inside. Workgroup performance priced for competition. Dynamic!

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Tektronix



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NEW Phaser 140



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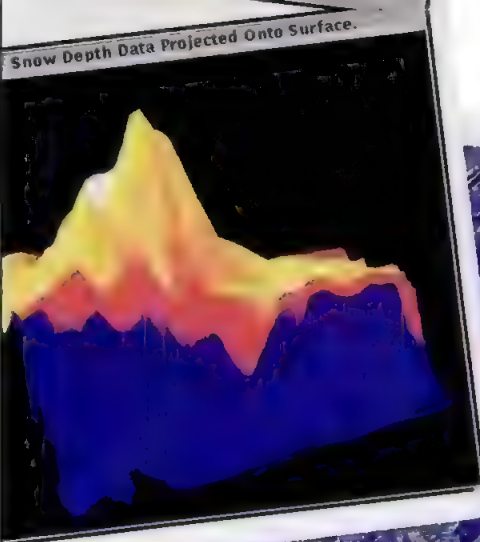
Phaser 220i



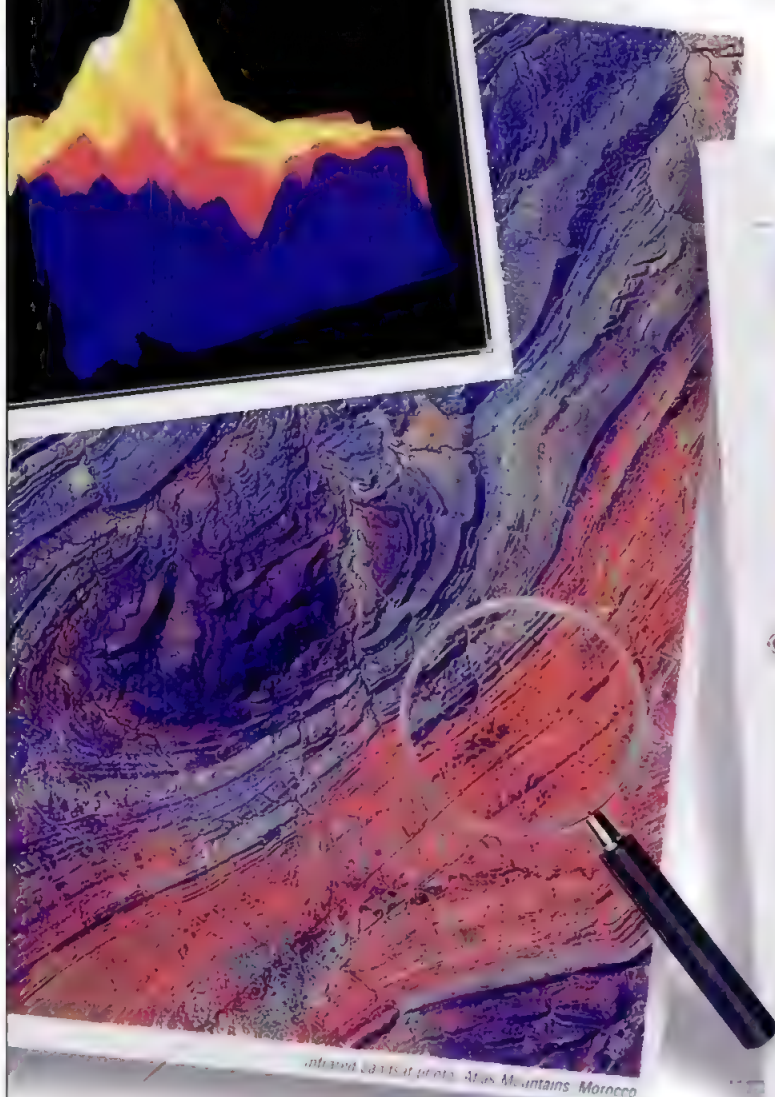
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CIRCLE 001 ON READER SERVICE CARD

Benchmark Tests: Personal/Workgroup Lasers

The fastest personal/workgroup laser of the pack was the TI microLaser Power Pro, which ran slightly faster than its rated engine speed of 12 pages per minute on our Text Speed test, turning in a score of 12.1 ppm in both the PCL and PostScript emulations. In fact, the TI printer was a leader across the board, with a Graphics Speed test score of 4.4 graphics pages per minute in PCL mode and 1.7 gppm in PostScript mode.

What the Numbers Mean

The Lexmark Winwriter 600 exceeded its rated engine speed of 8 ppm by 1 ppm on our Text Speed test (in PCL mode)—a fairly remarkable result and a testament to the Lexmark 4029 laser-engine design. Equally impressive was the Sharp JX-9460PS, whose 6-ppm Sharp 9640 engine yielded 6.7 ppm in PostScript text.

The TI microLaser Pro 600 PS23 had relatively poor PCL Text Speed test results of 3.6 ppm, but excelled in PostScript text, printing at 8.1 ppm. This is attributable to the fact that the microLaser Pro 600 is primarily a PostScript printer and converts incoming PCL print jobs into PostScript before printing them.

The three color lasers, the HP Color LaserJet, the QMS magicolor, and the Xerox 4900 Color Laser Printer, were relatively slow at printing monochrome text when compared with printers of the same engine speed. The magicolor, printing at 6.8 ppm and 6.6 ppm in PCL and Post-

Script monochrome text, respectively, was the second-slowest of the laser printers rated at 8 ppm. The Color LaserJet's PCL Text Speed test score of 8.6 ppm was the second-slowest of the laser printers rated at 10 ppm, and the 4900's PCL and PostScript Text Speed test scores of 8.2 ppm and 7.1 ppm, respectively, were at the bottom of the 12-ppm-engine category.

On our Microsoft Windows applications tests—Word for Windows, Lotus 1-2-3, and CorelDRAW—the fastest workgroup printers were the HP LaserJet 4 Plus and the HP LaserJet 4M Plus, both of which ran through the Word for Windows test at a rate of about 10 ppm. With increased print resolution (600 dots per inch), the HP duo barely slowed, achieving 9.7 ppm in PCL mode. On our Lotus 1-2-3 test (PCL mode), the Lexmark IBM LaserPrinter 4039 12R Plus took top honors, scoring 4.0 gppm. The 10-ppm QMS 1060 Print System proved the best at producing CorelDRAW graphics, with throughput of 2.0 gppm in PCL mode and 1.6 gppm in PostScript.

This year's roundup included five GDI printers—the Lexmark Winwriter 600 and the four entries from C-Tech Electronics. GDI printers, which are intended for Windows printing, do not use a printer description language such as PostScript or PCL (though the Winwriter does have resident PCL) but instead intercept the Windows Graphics Display Interface. The printers may rely partially or totally on the host machines' CPU memory for processing, eliminating costly parts and, in theory, improving performance. In GDI mode, the Lexmark Winwriter 600 excelled on our Windows applications tests, turning in the fastest scores among 8-ppm machines in this roundup. The C-Tech units, on the other hand, proved lackluster in text throughput but on a par with similarly rated printers in producing Lotus 1-2-3 and CorelDRAW pages.

pending on the state of the printer. Certain configuration changes, such as choosing manual paper feed or number of copies, are left to DOS and Windows utilities. With crisp type and smooth gray scaling for a 300-dpi printer, image quality is on a par with that of the HP LaserJet IIIp, which it emulates (PCL 5).

The LBP-860 has a more traditional control panel, complete with message window and buttons. A 250-sheet paper tray that fits flush inside the base contributes to the case's compact footprint. In enhanced PCL 5 mode at 600 dpi, the LBP-860 produced detailed text, sharp lines, and sharp images with excellent contrast. But 600-dpi performance was slower than that of other printers rated at the same speed, especially on our Windows applications tests. The similarly priced HP LaserJet 4

Plus and others offer 12 ppm and optional network adapters. Canon doesn't offer an optional network interface card for the LBP-860, though third-party adapters are available. This printer would have fared better in last year's field; this year, however, it is only an also-ran.

► **Canon LBP-430.** List price: \$799; 100-sheet universal cassette, \$40; 1MB SIMM, \$150; 4MB SIMM, \$360; toner/developer/drum unit, \$85. **Canon LBP-860.** List price: \$1,839; 250-sheet letter-size paper cassette, \$85; 500-sheet universal cassette, \$99; envelope feeder, \$299; toner/developer/drum unit, \$155; optional Adobe Level 2 PostScript, \$499. Canon Computer Systems Inc., 2995 Redhill Ave., Costa Mesa, CA 92626; 800-848-4123, 714-438-3075; fax, 714-438-3099.

Circle 469 on reader service card

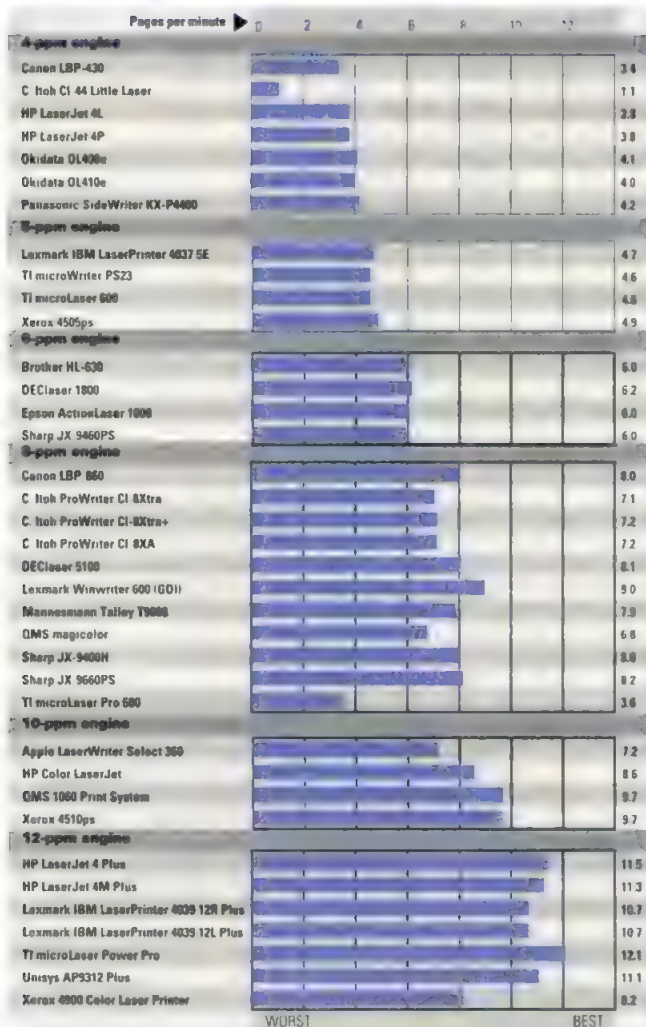
C-Tech Electronics Inc.

- **C. Itoh CI-44 Little Laser**
 - **C. Itoh ProWriter CI-8Xtra**
 - **C. Itoh ProWriter CI-8Xtra+**
 - **C. Itoh ProWriter CI-8XA**
-

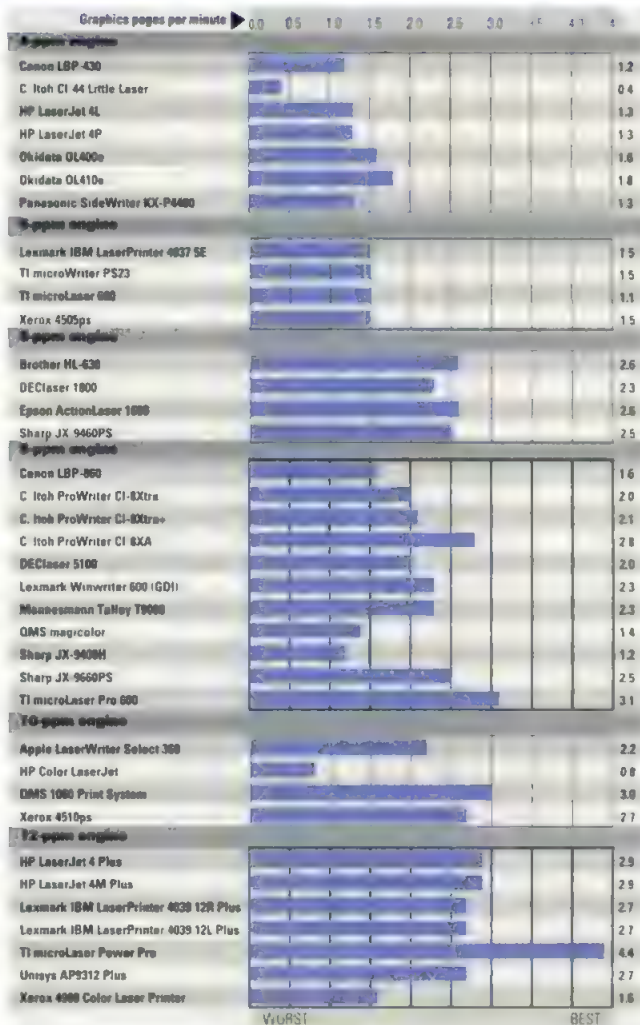
BY BILL DYSZEL

C-Tech Electronics' C. Itoh ProWriter CI-8Xtra, C. Itoh ProWriter CI-8Xtra+, and C. Itoh ProWriter CI-8XA, which are all based on 8-page-per-minute TEC 1323 engines, come with GDI drivers. Unlike most GDI printers, however, the C-Tech units have their own AMD 29200 RISC processors and support other emulations. The role of GDI here is not to make possible a

TEXT SPEED (PCL)



GRAPHICS SPEED (PCL)



stripped-down, Windows-only printer but to simulate 600-dot-per-inch printing by controlling laser intensity via C-Tech's XWIN utility. PCL 5 at 300 dpi is also standard on all three models. The CI-8Xtra+ (\$2,099 list, \$1,750 street) and CI-8XA (\$2,299 list, \$1,850 street) add a proprietary version of Adobe PostScript Level 2, which can also print at 600 dpi (not with C-Tech's DOS PostScript driver, however). The CI-8XA adds an AppleTalk port. No optional network interface is offered.

XWIN graphics were reasonably sharp, but banding was noticeable in gray-scale graphics. Performance results for all three printers were average or below for an 8-ppm printer; in PCL, the systems produced only 7 ppm and 2 to 3 graphics pages per minute. The CI-8Xtra+ and CI-8XA hovered at around

6 ppm for PostScript text and sank to a new low of 0.3 gppm for 600-dpi PostScript graphics. XWIN graphics scores at 600 dpi were considerably better, but they were still only average, with a score of 0.8 gppm in CorelDRAW tests.

Automatic emulation switching among PostScript, PCL, and XWIN on



C. Itoh ProWriter CI-8Xtra

the CI-8Xtra+ and CI-8XA worked smoothly. All these models have a full-featured 8-button printer control panel with a large, easy-to-read LCD. All three printers also feature a 250-sheet paper tray that accepts paper up to legal size. We did notice, however, that if the width setting was the least bit off on our test unit, the feed mechanism would wrinkle and tear the paper. It also was hard not to spill toner while assembling the somewhat cumbersome three-part toner developer package.

All three printers feature a complete, easy-to-use control panel with eight push buttons and a 16-character LCD. The buttons can be used to control paper handling, resolution, emulation, and many other functions.

The \$599 (\$399 street) C. Itoh CI-44

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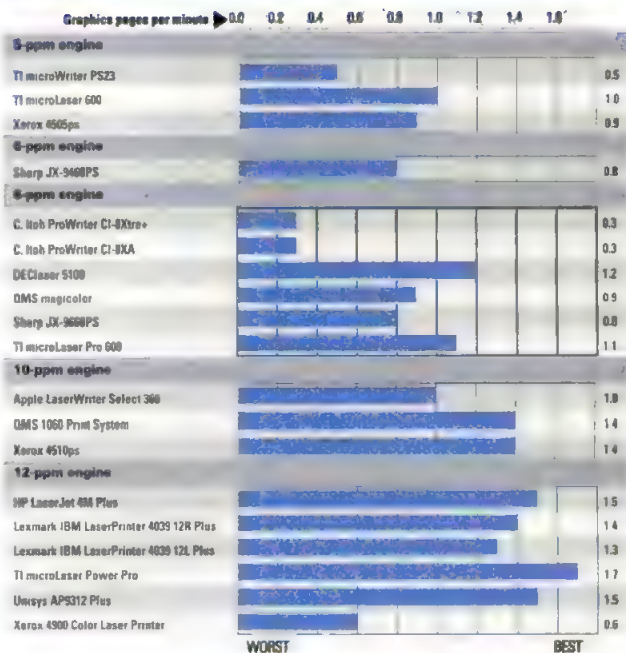
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GRAPHICS SPEED (POSTSCRIPT)



Of the 37 laser printers we tested in this roundup, 28 were Energy Star-compliant (using 30 watts or less while in power-saving mode for monochrome laser printers, 45 watts or less in power-saving mode for color laser printers), 3 claimed compliance but tested at 31 watts or more (the DEClaser 5100, Sharp JX-9400PS, and microLaser Power Pro), and 6 did not possess power-saving attributes. The most power-hungry printers were the three color lasers: the Color LaserJet, the magicolor, and the 4900. The Color LaserJet consumed the most power while printing (440 watts) but the least of all the color laser printers when in power-saving mode (36 watts). Heavy power usage in a color laser printer is not particularly surprising when you consider the complexity of its design. In sharp contrast to the power-hungry printers, the Canon LBP-430 required only 4 watts while in power-saving mode.

Little Laser is a more typical GDI printer: an economical choice for the Windows user who seldom uses a non-Windows application. Unlike the RISC-driven CI-8Xs, the 300-dpi CI-44 has no processor; it depends entirely on the host PC. Unfortunately, the CI-44 shows that small is not always beautiful.

The 4-ppm machine turned out Windows text at a slow 2.7 ppm, and it produced Windows graphics at 1.7 gppm. Bundled rasterizer software for PCL 4 makes DOS printing possible but not practical. Output slows to a crawl, and

we observed print to be faint and spotty.

While the unit's relatively small footprint (14.1 by 11.3 inches) and light weight (11 pounds) are welcome, its overall design is flimsy. A built-in door tended to flop open, cancelling our print jobs. On the plus side, blacks were solid and jagged edges were slight in our Windows printouts, thanks to the driver's proprietary Edge Enhancement Technology. The printer-control utility for Windows offers highly detailed real-time printer status reports in an easy-to-understand graphic format, and a dialog

box pops up immediately to report any printing errors as they occur.

► **C. Itoh CI-44 Little Laser.** List price: \$599; drum, \$99.95; 4-piece toner cartridge, \$19.95; PostScript Level 1 software, \$58.95. **C. Itoh ProWriter CI-8Xtra.** List price: \$1,799; 1MB RAM upgrade, \$185; 2MB RAM upgrade, \$335; 300-sheet letter- and A4-size paper tray, \$175; 300-sheet legal-size paper tray, \$175; 20-sheet faceup output tray, \$30; drum, \$124; 2-pack of toner cartridges, \$40. **C. Itoh ProWriter CI-8Xtra+.** List price: \$2,099 (same options

How We Tested

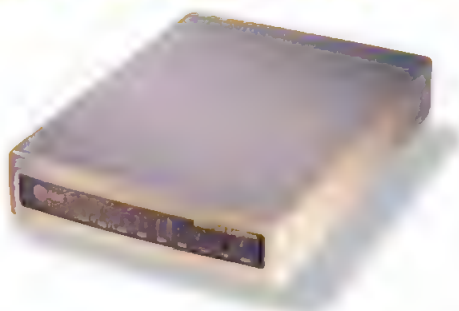
The **Text Speed** test measures the printer's speed in producing ten copies of a two-page business letter with 1-inch margins.

The **Graphics Speed** test measures the printer's speed in producing two copies of a complex single-page graphic containing a TIFF image, horizontal and vertical gray scales, and line art. A print file is sent to the parallel port directly from DOS.

The **Word for Windows** test measures the printer's speed in producing a ten-page report that uses multiple fonts and type styles. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

The **Lotus 1-2-3 for Windows** test measures the printer's speed in producing a complex two-page spreadsheet that contains pie, bar, and line charts. We tested each printer with the Microsoft Windows printer driver that was recommended by the printer's manufacturer.

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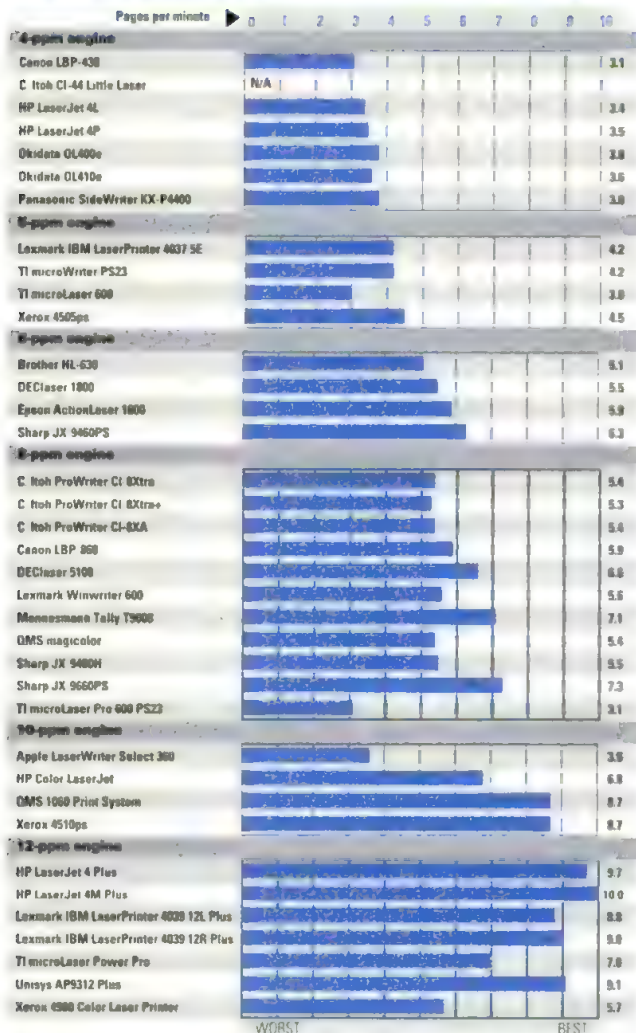
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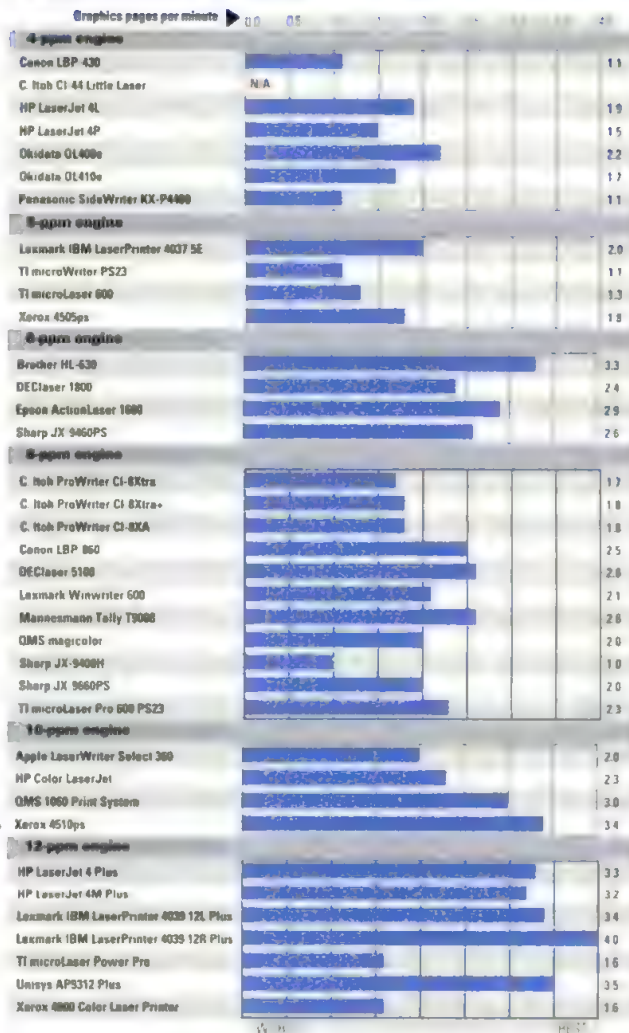
Benchmark Tests: Personal/Workgroup Lasers

WORD FOR WINDOWS (PCL)



N/A—Not applicable. The printer does not support PCL mode.

LOTUS 1-2-3 (PCL)



and prices as above). **C. Itoh ProWriter CI-8XA**. List price: \$2,299 (same options and prices as above). C-Tech Electronics Inc., 2701 Dow Ave., P.O. Box 2098, Tustin, CA 92681; 800-347-4017, 714-573-4604; fax, 714-757-4533.

Circle 470 on reader service card

Digital Equipment Corp.

• **DEC Laser 1800**

• **DEC Laser 5100**

BY STEVEN C.M. CHEN

With its plentiful supply of fonts and long list of options, Digital's 8-ppm, 600-dpi DEC Laser 5100 (list price, \$1,599) is almost a winner. Unfortunately, poor emulation switching limits this model to less demanding workgroup printing environ-

ments. Listing at \$779, the 6-ppm DEC Laser 1800 is an inexpensive personal printer with average-looking 300-dpi output.

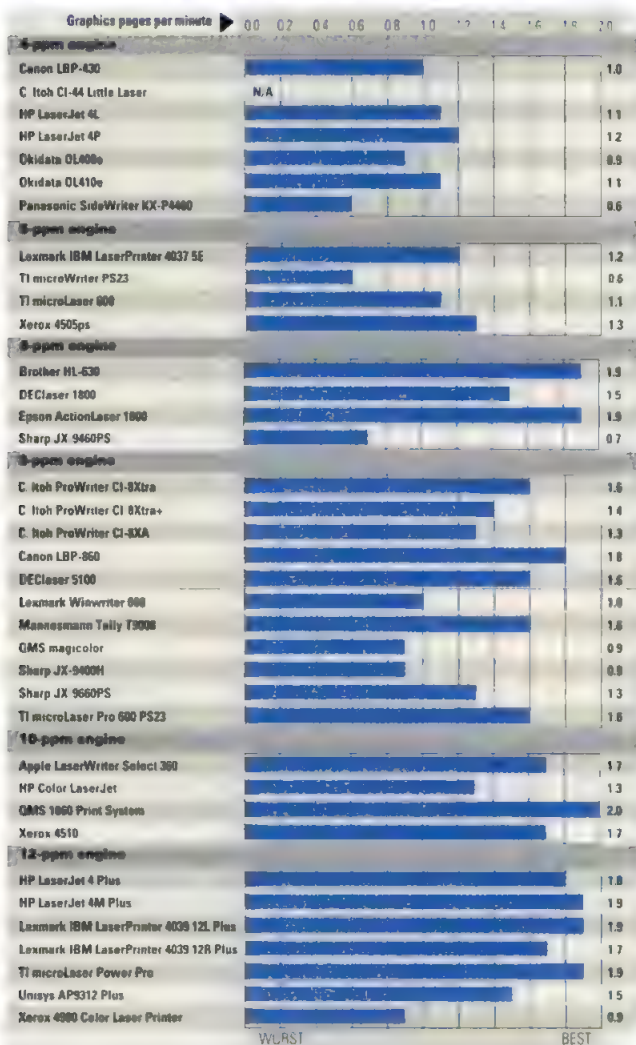
A solid performer on our benchmark tests, the Canon LBP-EX-based DEC Laser 5100 hovered just above its rated 8-ppm speed in PCL 5e and dipped just below it in PostScript. Graphics performance at 600 dpi was slightly above average, with 1.1 graphics pages per minute on the Graphics Speed test and 1.2 gppm on the Windows-based CorelDRAW test. Output quality was fine with crisp text and slight banding in gray-scale graphics. The 5100's resident font collection is huge—47 faces in PCL, 73 in Adobe. Options include memory expansion to 66MB using standard SIMMs, an

Ethernet card (\$399), a 500-sheet paper tray (\$289), and an envelope feeder (\$289). A \$399 1,200-dpi upgrade and a \$499 128MB hard disk option were not yet available at the time of this review.

Digital provides an optional Ethernet interface but offers no utility of its own



CORELDRAW (PCL)



N/A—Not applicable. The printer does not support PCL mode

for setup routines; you must rely on NetWare's PCONSOLE instead. We found the control panel's many layers of menus difficult to work with. Port switching among parallel, serial, AppleTalk, and network interfaces worked consistently, but emulation sensing, reliable under Windows, sometimes failed altogether under DOS. A representative from Digital told us the company was working on a ROM upgrade to fix the problem.

The 16-MHz AMD 29200 RISC processor gives the 1800 good throughput for a 6-ppm personal laser printer. Text and graphics quality is average for a 300-dpi printer with resolution enhancement. The 1800 comes with 1MB of RAM expandable to 5MB using standard SIMMs and a single 150-sheet multipurpose paper

tray. A 250-page sheet feeder (\$199) is optional. No network options are available.

► DECleraser 1800.

List price: \$779; 1MB SIMM, \$149; 4MB SIMM, \$200; paper cassette (250 sheets), \$199; combined toner/developer/drum, \$129. **DECleraser 5100.** List price: \$1,599; 4MB SIMM, \$200; 16MB SIMM, \$800; 32MB SIMM, \$1,600; 1,200-dpi upgrade, \$399; paper cassette (500 sheets), \$89; 500-page paper feeder, \$289; envelope feeder, \$289; combined toner/developer/drum, \$115; Ethernet network interface, \$399. Digital Equipment Corp., 146 Main St., Maynard, MA 01754-2571; 800-777-4343, 508-493-5111; fax, 800-234-2298.

Circle 471 on reader service card

Epson America Inc.

● Epson ActionLaser 1600

BY MARINO DELZOTTO

With its 6-page-per-minute ActionLaser 1600 (\$1,199 list, \$1,000 street), Epson attempts to carve out a niche in the 600-dot-per-inch presentation and business graphics market by attacking the problem of resolution improvement three ways. Resolution Improvement Technology smooths jaggies. Super MicroArt Printing (the use of finer and more consistently sized toner particles) raises general image quality. MicroGray Technology, available only with Epson's optional PostScript emulation (\$329), increases the number of gray levels. Epson claims the AL1600 ri-

vals 1,200-dpi resolution when printing gray-scale graphics. We found the printed image had excellent detail but tended to be high-contrast and a little dark. With the PostScript Level 2 emulation installed, the AL 1600 offers automatic emulation switching.

Performance of the Minolta SP-6XH engine was above average. 300-dpi text came out at 6 ppm. Graphics performance was outstanding; 2.6 graphics pages per minute at 300 dpi is a better showing than that of all but two of the 8-ppm printers we reviewed. At 600 dpi, the AL1600's 2.1-gppm Graphics Speed score has no



Epson ActionLaser 1600

competition from other 6-ppm or 8-ppm models.

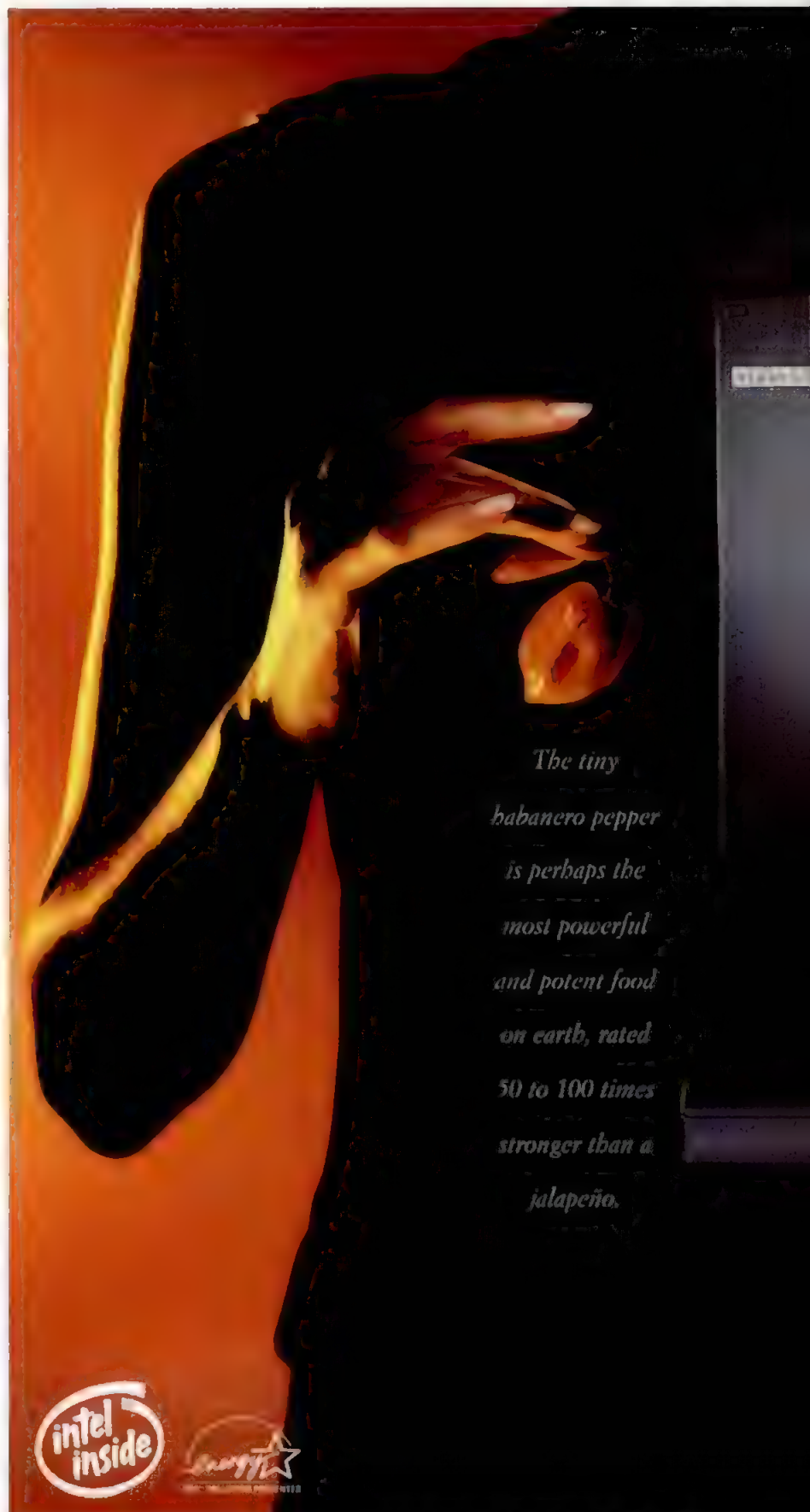
The 150-sheet cassette is small for most offices, and business users would probably need to add an optional 250-sheet letter-size feeder (\$219).

The AL 1600's General Reference Guide is straightforward and readable. Setting up the optional internal Ethernet network interface card—a potential nightmare—couldn't have been simpler. Put in the Epson disk and the network immediately reads the serial number and recognizes Microsoft Windows' HP LaserJet 4 printer driver.

The optional network interface card does not include remote management software. Nonnetwork users can select paper size, paper tray, density, and other features from their PC through the Windows driver, however.

► **Epson ActionLaser 1600.** List price: \$1,199; replacement cartridge, \$179; 250-page letter-size feeder, \$219; 20-sheet face-up output tray, \$15; PostScript Level 2 clone, \$329; Macintosh connectivity kit (with LocalTalk interface and PostScript Level 2 clone), \$399; serial or parallel interface, \$152; coaxial interface, \$699; twinaxial interface, \$669; Ethernet inter-

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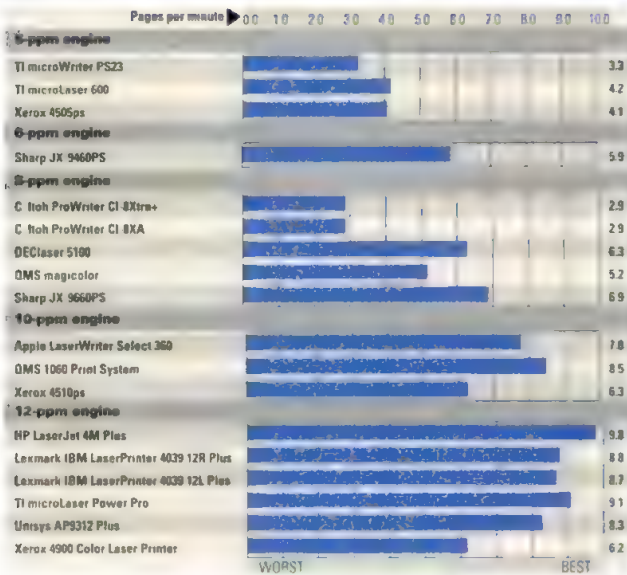


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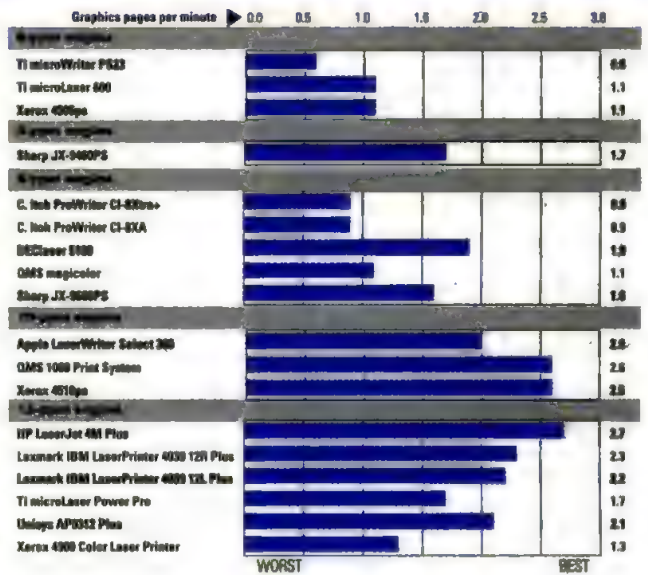
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WORD FOR WINDOWS (POSTSCRIPT)



LOTUS 1-2-3 FOR WINDOWS (POSTSCRIPT)



face, \$499. Epson America Inc., 20770 Madrona Ave., Torrance, CA 90503; 800-289-3776, 310-782-0770; fax, 310-782-4248.

Circle 472 on reader service card

Hewlett-Packard Co.

- **HP LaserJet 4L**
- **HP LaserJet 4P**

EDITORS' CHOICE
HP LaserJet 4 Plus

- **HP LaserJet 4M Plus**
- **HP Color LaserJet**

BY JOSEPH DESPOSITO

Hewlett-Packard succeeds at just about every level with a quintet of printers that offer superior performance and features, including color in one case, at competitive prices. For the small-office or home user, there is the 300-dot-per-inch HP LaserJet 4L, an Editors' Choice selection last year, which lists for \$849 (\$630 street). The 4L is identical to the LaserJet 4ML, except that the 4ML comes with Adobe PostScript Level 2, 4MB of RAM, and a LocalTalk port for \$1,279 list. For the price-conscious business user, the HP LaserJet 4P, another 1993 Editors' Choice recipient, provides 600-dpi resolution for a suggested list price of \$1,229 (\$925 street). The 4P is identical

to the LaserJet 4MP but the 4MP also comes with an Adobe PostScript Level 2 interpreter, 6MB of RAM, and a LocalTalk port for \$1,729 list (\$1,300 street). For corporate users, the new HP LaserJet 4 Plus and the LaserJet 4M Plus offer 12 pages per minute at list prices of \$1,839 (\$1,375 street) and \$2,479 (\$1,950 street), respectively. Finally, the new HP Color LaserJet adds a bright new dimension to laser printing at a list price of \$7,295; no street price was available at the time of review.

All the LaserJets are power-pinchin' units, with the basic 4L turning itself off after 15 minutes of inactivity. All offer an EconoMode used for draft printing that consumes half the usual toner. All except the 4L and the 4ML employ resolution enhancement for smoothing jagged edges in text output. All come with a Bi-Tronics parallel port, which enables status reports to be sent back to the user, and Memory Enhancement technology, which compresses data to make more efficient use of memory.

The high-tech design of the 4L eschews

a power switch. This 4-page-per-minute printer uses the Canon PX engine and comes with a 100-sheet paper cassette, 1MB of RAM, and 26 scalable Intellifont typefaces. The 4L's text and graphics are crisp and well defined, with jaggies only slightly evident. Its speed is comparable to others in its class.

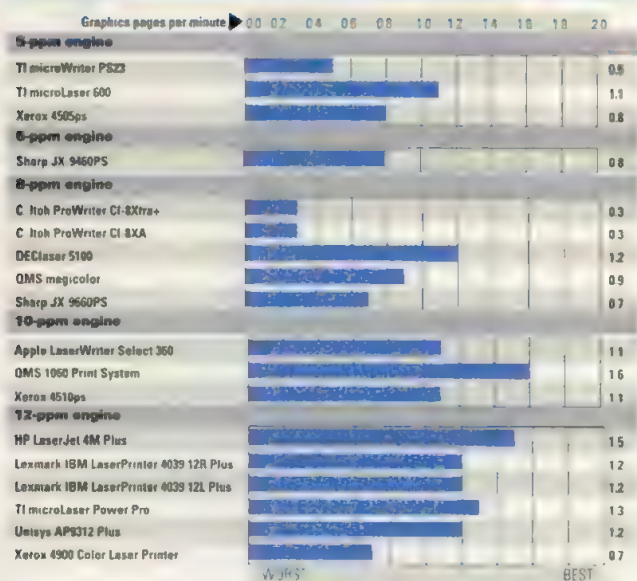
The 600-dpi resolution of the 4P's Canon PXII engine is a key ingredient in producing superb output, but at 4 ppm, the engine is among the slowest for printers in its price range. Standard items with the 4P are a 250-sheet paper cassette, 2MB of RAM, and 45 scalable typefaces (35 Intellifont and 10 TrueType). Text and graphics are crisp and well defined, with jagged edges nearly imperceptible.

The 4 Plus and 4M Plus are identical, except that the 4M Plus has several key options built in.

Whereas the 4 Plus comes standard with 2MB of RAM, the 4M Plus sports 6MB. The 4M Plus also has a built-in Adobe PostScript Level 2 SIMM, and a built-in HP JetDirect card for connecting to LocalTalk and Ethernet networks. A 25-MHz Intel 80960 and the 600-dpi, 12-ppm Canon



CORELDRAW (POSTSCRIPT)



EX engine assure high performance and superb print quality. Text and graphics quality are on a par with those of the 4P, but the 4M Plus' print speed is among the fastest of the workgroup laser printers we reviewed.

The internal JetDirect network interface card, standard with the 4M Plus, is optional with the 4 Plus. Installation of each printer onto the network is done for you by the HP JetAdmin utility, which handles plenty of remote management functions as well as drag-and-drop printing.

The HP Color LaserJet adds a new dimension of color output to the LaserJet line. A 300-dpi text and graphics printer using PCL 5 (PostScript is a \$799 option), the Color LaserJet has four toner reservoirs, one each for cyan, magenta, yellow, and black. Unlike the QMS magicolor and the Xerox 4900 Color Laser Printer, however, which have four separate developer assemblies, the Color LaserJet has two. Powered by a 20-MHz AMD 29030 RISC processor, this printer is rated at 2 color ppm and 10 monochrome ppm.

The HP Color LaserJet's 300-dpi resolution produces output inferior to that of the 600-by-600 magicolor and the 1,200-by-300 4900. While colors were bright, dithering patterns were noticeable, especially in the orange slice of the pie chart in

our business graphic. Still, color output is perfectly acceptable for the average business application and the convenience of mixing black and color laser output on the same page is undeniable. Keep in mind, also, that the Color LaserJet's list price is \$2,704 less than the magicolor and \$1,200 less than the 4900, and its cost per page (with 20 percent coverage) is 10.7 cents compared with the magicolor's 20 cents and 4900's 25 cents.

The Windows driver for the Color LaserJet comes with HP's ColorSmart, which adjusts colors automatically for text, business graphics, and continuous tone images, even if they're on the same page.

► **HP LaserJet 4L.** List price: \$849; 1MB RAM upgrade, \$99; toner/developer/drum unit, \$89. **HP LaserJet 4P.** List price: \$1,229; 1MB RAM upgrade, \$119; 2MB RAM upgrade, \$209; 4MB RAM upgrade, \$309; 8MB RAM upgrade, \$579; Adobe PostScript Level 2 SIMM, \$299; HP JetDirect for Ethernet, \$369; HP JetDirect for Token-Ring, \$619; toner/developer/drum unit, \$85. **HP LaserJet 4 Plus.** List price: \$1,839; 1MB RAM upgrade, \$119; 2MB RAM upgrade, \$209; 4MB RAM upgrade, \$309; 8MB RAM upgrade, \$579; 16MB RAM upgrade, \$1,299; Adobe PostScript Level 2 SIMM, \$399; 1,000-sheet output stacker, \$389; 500-sheet paper cassette, \$349; power envelope feeder, \$349; HP JetDirect for Ethernet/LocalTalk, \$429; HP JetDirect for Token-Ring, \$619; HP-UX interface, \$199; SunOS interface, \$199; toner/developer/drum unit, \$155. **HP LaserJet 4M Plus.** List price: \$2,479; 1MB RAM upgrade, \$119; 2MB RAM upgrade, \$209; 4MB RAM upgrade, \$309; 8MB RAM upgrade, \$579; 16MB RAM upgrade, \$1,299; 1,000-sheet output stacker, \$389; 500-sheet paper cassette, \$349; power en-

velope feeder, \$349; HP JetDirect for Token-Ring, \$619; HP-UX interface, \$199; SunOS interface, \$199; toner/developer/drum unit, \$155. **HP Color LaserJet.** List price: \$7,295; 1MB SIMM, \$119; 2MB SIMM, \$209; 4MB SIMM, \$309; 8MB SIMM, \$579; 16MB SIMM, \$1,299; Adobe PostScript Level 2 SIMM, \$799; 250-sheet rear paper feeder, \$445; printer cabinet, \$395; additional paper cassettes, \$122 each; black toner bottle, \$8.95; cyan/magenta/yellow toner bottles, \$43.95 each; black developer, \$210; color developer, \$599; fuser, \$280; print drum, \$369; transfer unit, \$197; coating and pad kit, \$57.95; toner collection kit, \$29.95; HP JetDirect for Ethernet and LocalTalk, \$429; HP JetDirect for Ethernet, \$369; HP JetDirect for Token-Ring, \$619; HP support pack (extends on-site next day response service to three years), \$2,000. Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, MS511L-SJ, Santa Clara, CA 95051; 800-752-0900; fax, 800-333-1917.

Circle 473 on reader service card

Lexmark International Inc.

- **IBM LaserPrinter 4037 5E**
- **Lexmark Winwriter 600**
- **IBM LaserPrinter 4039 12R Plus**
- **IBM LaserPrinter 4039 12L Plus**

Unisys Corp.

- **Unisys AP9312 Plus**

BY STEVEN C.M. CHEN

Former IBM division Lexmark offers two entry-level printers—one PCL, one GDI—plus two high-end variations on the same 12-page-per-minute theme. The





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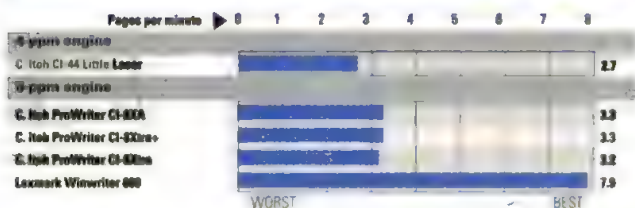
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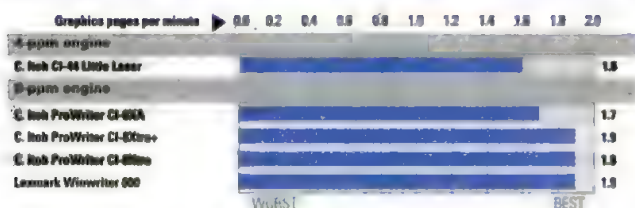
WORD FOR WINDOWS (GDI)



LOTUS 1-2-3 FOR WINDOWS (GDI)



CORELDRAW (GDI)



The **CorelDRAW** test measures the printer's speed in producing a single-page CorelDRAW graphic that contains a TIFF image, horizontal and vertical gray scales, and line art. We tested each printer with the Microsoft Windows printer driver recommended by the printer's manufacturer.

The **Power Consumption** test measures the printer's energy usage under three conditions: when printing, when idle, and when in power-saving mode (where available).

POWER CONSUMPTION

	Power consumption at rest (watts)	Power consumption when printing (watts)	Power consumption in power-saver mode (watts)
Apple LaserWriter Select 360	130	50	17
Brother HL-630	N/A	N/A	N/A
Canon LBP-430	130	4	4
Canon LBP-860	140	71	N/A
C. Itoh CI-44 Little Laser	99	34	9
C. Itoh ProWriter CI-8Xtra	161	71	14
C. Itoh ProWriter CI-8Xtra+	197	86	15
C. Itoh ProWriter CI-8XA	199	61	16
DECclass 1000	187	66	N/A
DECclass 5100	183	90	31
Epson ActionLaser 1000	196	82	14
HP Color LaserJet	440	112	36
HP LaserJet 4L	116	4	N/A
HP LaserJet 4P	121	7	N/A
HP LaserJet 4 Plus	287	76	20
HP LaserJet 4M Plus	279	77	23
Lexmark IBM LaserPrinter 4037 5E	166	47	7
Lexmark Winwriter 600	198	51	13
Lexmark IBM LaserPrinter 4039 12R Plus	202	59	28
Lexmark IBM LaserPrinter 4039 12L Plus	200	57	21
Mannesmann Tully T9000	182	49	19
Okidata OL400e	127	12	12
Okidata OL410e	121	43	12
Panasonic SideWriter KX-P4400	94	37	N/A
QMS 1000 Print System	240	86	17
QMS magicolor	234	118	N/A
Sharp JX-8480H	146	42	21
Sharp JX-8480PS	158	53	31
Sharp JX-8600PS	187	57	27
Ti microWriter PS23	130	43	N/A
Ti microLaser 800	134	41	13
Ti microLaser Pro 600 PS23	123	41	21
Ti microLaserPower Pro	213	61	31
Unisys AP9312 Plus	265	63	20
Xerox 4505ps	132	58	23
Xerox 4510ps	208	67	28
Xerox 4800 Color Laser Printer	130	346	46

N/A—Not Applicable. This printer's power cord was not compatible with our Dranetz device.

N/A—Not applicable. This printer does not have a power-saver mode.

IBM LaserPrinter 4037 5E (\$799 list, \$700 street), a 5-ppm PCL 4 printer holds its own at the low end with its full line of paper options and straightforward control panel. The Lexmark Winwriter 600 (\$1,199 list; \$1,049 street) offers 600 dots per inch to Windows users via GDI, at a rated speed of 8 ppm, and 300 dpi to DOS users via PCL 4 at a rated speed of 10 ppm. Two models based on the Lexmark 4039 12-ppm laser engine and powered by a 16-MHz AMD 29200 RISC processor improve on last year's Lexmarks by including full 600-dpi support for PCL 5e and PostScript Level 2 as well as remote management features.

The 4037 5E's 16-character by 4-line LCD sets it apart from other low-end printers by leaving ample room for intelligible instructions in plain English. Text is

dark and grays are well dithered for 300 dpi. Text output, at 4.7 ppm, falls slightly short of the rated speed. Graphics performance, at 1.5 graphics pages per minute, is about average for a printer in this price range.

The Winwriter 600, which comes with one 200-sheet letter-size paper cassette, is one of the first GDI printers to use Microsoft At Work software to access available processing power and memory from your PC. On our Windows applications tests the printer's GDI mode outscores most 600-dpi PCL printers at 1.3 gppm on our CorelDRAW test and 5.9 gppm on our Word for Windows test. The Winwriter 600 was also fast in its 300-dpi DOS PCL 4 emulation, printing 2.3 gppm on our Graphics Speed test. The control panel is minimal; controls and printer sta-

tus messages can be accessed from an included Windows-based utility. Output was clean and crisp, with minimal banding in gray-scale graphics.

The IBM LaserPrinter 4039 12L Plus, which comes with a 500-sheet paper cassette, lists for \$2,299 (\$1,900 street). The IBM LaserPrinter 4039 12R Plus, with a smaller 200-sheet standard paper cassette and lower duty cycle, lists at \$1,749 (\$1,400 street). The 12R Plus's identical twin, the Unisys AP9312 Plus (an OEM unit made by Lexmark for Unisys), lists at \$1,895 (\$1,400 street).

The 12L Plus, 12R Plus, and AP9312 Plus offer excellent remote printer management. The new Windows-based MarkVision utility makes installation a breeze and recreates the printer control panel (green background and all) on the

user's screen, complete with active buttons the user can click to access control panel functions. Novell's NetWare administrators can monitor multiple Lexmarks, with MarkVision helping to track and correct printer problems. Both the 12R Plus and the AP9312 Plus support optional Ethernet and Token-Ring interface cards, which can switch automatically among most of the popular NOSs. An external network interface box is available for the 4037 5E. Included with the interfaces is a DOS-based utility, which monitors printers remotely and can bypass NetWare 3.x's PCONSOLE completely.

Text output from all three printers was crisp; 600-dpi graphics in both PCL and PostScript showed some gray-scale banding but were of acceptable quality. Graphics performance at 600 dpi was 1.8 gppm in PCL and 1.0 gppm in PostScript, both slightly below average for a 12-ppm engine.

► **IBM LaserPrinter 4037 5E.** List price: \$799; 1MB SIMM, \$109; 2MB SIMM, \$189; 4MB SIMM, \$279; 256K flash memory, \$99; 1MB flash memory, \$199; 150-sheet letter-size cassette, \$49; 150-sheet legal-size cassette, \$59; 250-sheet letter or legal drawer, \$189; toner/developer/drum unit, \$114. **Lexmark Winwriter 600.** List price: \$1,199; 1MB SIMM, \$109; 2MB SIMM, \$189; 4MB SIMM, \$279; 200-sheet letter-size cassette, \$69; 200-sheet legal-size cassette, \$79; 200-sheet A5-size cassette, \$109; 500-sheet letter-size cassette, \$129; 500-sheet legal-size cassette, \$139; envelope feeder, \$349; toner/developer/drum, \$259. **IBM LaserPrinter 4039 12R Plus.** List price: \$1,749; 2MB SIMM, \$199; 4MB SIMM, \$299; 8MB SIMM, \$499; 1MB flash memory, \$289; 2MB flash memory, \$469; 4MB flash memory, \$799; 500-sheet duplex option, \$699; multimedia feeder (holds 100 sheets of letter-size paper or 75 envelopes), \$349; 100-sheet auxiliary letter feeder, \$229; 500-sheet second feeder and cassette, \$349; 500-sheet legal feeder and cassette, \$359; MarkNet 10BaseT adapter, \$439; MarkNet 10Base2 adapter, \$489; MarkNet Token-Ring adapter, \$649; MarkNet LocalTalk adapter, \$299; MarkNet XL 10BaseT adapter (XL series includes TCP/IP support), \$499; MarkNet XL 10Base2 adapter, \$549;

MarkNet XL Token-Ring adapter, \$699; toner/developer/drum, \$269. **IBM LaserPrinter 4039 12L Plus.** List price: \$2,299; same options as the 12R Plus, except it uses a 130-sheet duplex unit, \$699. Lexmark International Inc., 740 Circle Rd. NW, Lexington, KY 40511; 800-358-5835, 606-232-2000; fax, 606-232-2380.

Circle 474 on reader service card

► **Unisys AP9312 Plus.** List price: \$1,895; same options and prices as the 12R Plus, except the 4MB flash memory is \$859, and there are no LocalTalk or TCP/IP-compatible adapters. Unisys Corp., 4110 Plymouth Rd., Plymouth, MI 48170; 800-448-1424, 716-292-0880; fax, 716-272-6671.

Circle 475 on reader service card

Mannesmann Tally Corp.

• Mannesmann Tally T9008

BY JOSEPH DESPOSITO

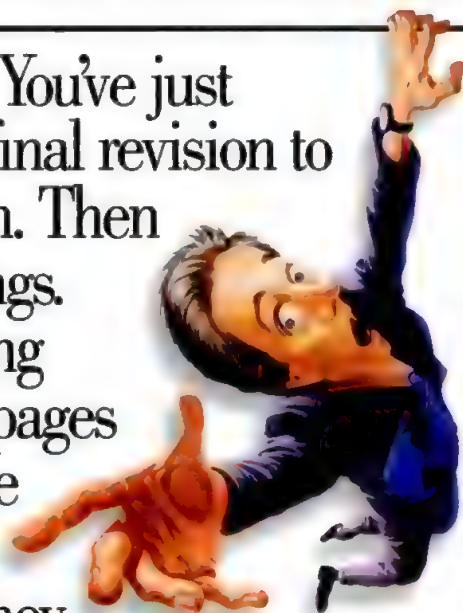
The \$1,499 Mannesmann Tally T9008 (estimated street \$1,199) has all the standard features of today's workgroup laser printer: 600-dot-per-inch PCL 5e output; simultaneously active serial and parallel in-



terfaces; a 20-MHz Intel i80960KA RISC processor; an 8-page-per-minute TEC LB 3500 engine; a 30-watt, power-saving sleep mode; and Mannesmann Tally's own Edge Enhancement Technology for smoothing text and graphics jaggies. An optional internal Ethernet adapter (\$399) gives the printer the potential for remote management from a PC. Unfortunately, Mannesmann Tally's DOS and Windows network utilities were not ready in time for this review. Neither was a \$1,799 PostScript model, the T9008PS.

The T9008 comes with 45 PCL 5e fonts, but users who want PostScript will

It's 3:50 pm. You've just finished the final revision to the sales plan. Then the phone rings. "We're sending over 10 new pages of competitive info." Click. Good thing they lock the windows on this floor. You have to get it into the plan by the end of the day. What now?



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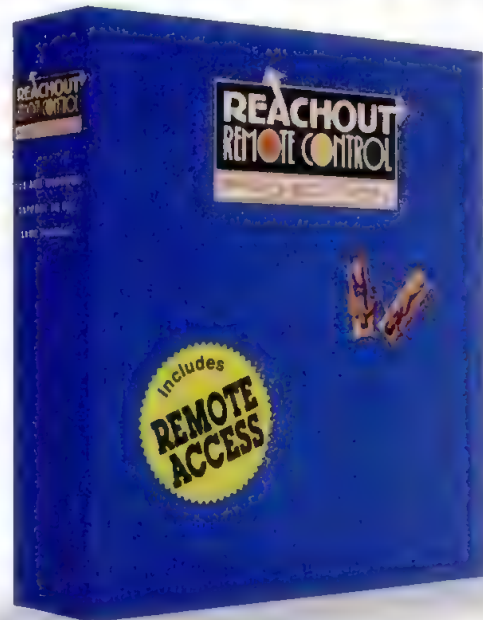
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Learning

✓ #1 Ease of Use

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The 45-page review for *Software Digest* covered all the bases. It was the most extensive review ever done on remote control software. In the end, the experts called ReachOut Remote Control simply "the best program in the...evaluation." It outscored the competition in not one, not two or three, but in seven categories. In its report for *Software Digest's* June '94 issue, National Software Testing Laboratories wrote:

NSTL recommends ReachOut Remote Control for its excellence in almost every category. No other program matches its number of features or ease of use, and it is the unanimous choice for best program in the testers' general usability evaluation.

The recommendation confirms the findings of exhaustive corporate evaluations. And it parallels assessments by such leading publications as *Byte*, *LAN Magazine*, *PC User*, *Network Computing*, *Government Computer News* and *InfoWorld*.

But why not judge for yourself? We will be happy to send you more information on the NSTL report. Better yet, take advantage of our 60-day money-back guarantee and order your copy of ReachOut today. Call 1-800-677-6232 for your nearest dealer location.

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SOFTWARE DIGEST RATING	OVERALL EVALUATION	PROGRAM
★★★★	8.5	Reachout Remote Control
★★★	7.5	Close-Up
★★★	7.3	Norton pcANYWHERE 1.0 for Windows
★★★	7.3	Carbon Copy for Windows

have to pay an additional \$325 for Destiny Page Styler, a PostScript Level 2 clone. Output for PCL text is typical for 600-dpi printers, but graphic images are on the dark side.

The T9008 hit above-average scores on our applications tests. PCL throughput at 300 dpi was 7.9 ppm for text and 2.3 graphics pages per minute for graphics. In 600-dpi PCL 5e the T9008 turned out 1.9 gppm, outclassing the Canon LBP-860 and the DEClaser 5100. Windows applications test scores were similarly strong for a printer in this price range.

The T9008's 250-sheet adjustable cassette and 100-sheet multipurpose feeder tended to jam and sometimes the paper didn't feed at all, though Mannesmann Tally was able to solve these problems. The only paper option for the T9008 is a second 500-sheet paper bin.

► **Mannesmann Tally T9008.** List price: \$1,499; 1MB SIMM, \$115; 2MB SIMM, \$205; 4MB SIMM, \$279; 8MB SIMM, \$539; second 500-sheet bin, \$299; PostScript option, \$325; toner/developer/ drum kit, \$199; AppleTalk interface, \$120; Ethernet adapter, \$399. Mannesmann Tally Corp., 8301 S. 180th St., P.O. Box 97018, Kent, WA 98064; 800-843-1347, 206-251-5524; fax, 206-251-5520.

Circle 476 on reader service card

Okidata

- **Okidata OL400e**
- **Okidata OL410e**

BY EDWARD MENDELSON

Okidata's low-priced OL400e and OL410e are 4-page-per-minute LED page printers designed for home offices and individual users. Identical in their compact size, power-saving sleep mode, straightforward front panel controls, and 100-sheet built-in paper capacity, the two models differ primarily in their emulations. The \$699 OL400e (street around \$500) emulates the 300-dot-per-inch HP LaserJet IIp Plus. The \$899 OL410e (about \$700 street) emulates the HP LaserJet III, but its drivers and firmware enhance its 300-dpi output to resemble output from 600-dpi models. Both models fill only 1.3 square feet of desk space, although pull-out output trays increase the printer's length from 14.5 to 17 inches. Hardware installation is straightforward,

with separate conductor cartridge and toner. Okidata also markets the OL410e PS, identical to the OL410e with added PostScript emulation and an AppleTalk port, for \$1,249 but it was not sent to us in time for review.

The OL400e, an Editors' Choice recipient in 1993, comes with 512K of RAM (expandable to 4.5MB) and 44 bitmap fonts. The OL410e, which emulates the LaserJet III, has 2MB of RAM (expandable to 5MB), and 12 HP-compatible scalable fonts. Proprietary font cards let you add HP-compatible bitmapped fonts to the OL400e and OL410e.

Okidata also boosts the OL410e's effective resolution to 300-by-1,200 through a proprietary enhancement technique the company claims creates 600-by-600-dpi print quality. While superior to ordinary 300-dpi output, it's still grainier and less subtle than the output from true 600-dpi hardware. Both models produce dark and consistent blacks and smooth shading.

Both the OL400e and OL410e print text at about 4 ppm; the OL400e prints graphics at 1.6 graphics pages per minute,



the OL410e at 1.8 gppm—relatively fast speeds for this class of printer. Okidata's LED printers do not offer the speed or paper capacity of slightly more expensive models but for individual users, they're exceptionally compact and economical.

► **Okidata OL400e.** List price: \$699; 1MB RAM upgrade, \$119; 100-sheet multipurpose cassette, \$149; 250-sheet legal universal (holds legal or smaller) lower cassette, \$259; Tax II font card, \$149; Barcodes Plus II font card, \$149; Microdocks II font card, \$149; OKIPRO II font card, \$229. **Okidata OL410e.** List price: \$899; 1MB RAM upgrade, \$174; 100-sheet multipur-

You think she's finishing the proposal. She thinks you are. Surprise, neither one of you are. And it's 4 hours before the grant committee meets. Let's see, 16 new pages of data, 11 article reviews, 3,600 words sent by your partners in Istanbul. Who can type faster? Aaargh! What now?



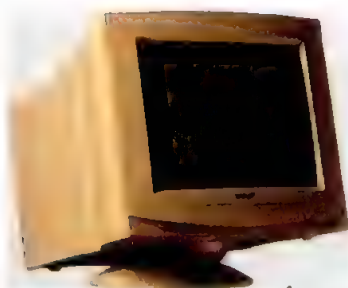
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CIRCLE 067 ON READER SERVICE CARD



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pose cassette, \$149; 250-sheet legal universal lower cassette, \$259; same font cards as the OL400e. Okidata, 532 Fellowship Rd., Mount Laurel, NJ 08054; 800-654-3282, 609-235-2600; fax, 609-778-4184.

Circle 477 on reader service card

Panasonic Communications & Systems Co.

• Panasonic SideWriter KX-P4400

BY JOSEPH DESPOSITO

Designed for use in a small or home office, the Panasonic SideWriter KX-P4400 LED page printer handles basic printing needs at a rock-bottom price. Listing for \$699 and selling on the street for about \$449 (\$399 with a \$50 rebate in effect through December 31, 1994), the KX-P4400 offers 300-dot-per-inch resolution and PCL 4 compatibility at a rated speed of 4 pages per minute.

The KX-P4400 owes its SideWriter nickname to its mini-tower design. Its 5-by-12-inch footprint makes it the smallest of this group. Setup was straightforward until we got to the Panasonic engine's separate toner cartridge and drum. The need to tape over a small opening in the toner housing to prevent powder from spilling made cartridge installation awkward. Panasonic claims later units have a different installation that doesn't require tape. A 100-sheet multipurpose paper tray opens on the right side of the KX-P4400, almost doubling its 5-inch width. A 50-sheet exit tray opens at the top, adding a few inches to the height. The biggest problem was printing envelopes. The feeder took them in, but the printer invariably choked on them as they came out.

In performance testing, the KX-P4400 printed text slightly faster than 4 ppm, its rated speed. Graphics printed one-third



Panasonic SideWriter KX-P4400

as fast as its rated speed. At 0.6 graphics pages per minute, graphics printing in our CorelDRAW test was on the slow side, however. Graphics printed well, with just slight gray-scale banding. Text printing is dark and even but the lack of resolution enhancement clearly shows in jagged curves and lack of definition at smaller font sizes.

The KX-P4400 comes standard with 1MB of RAM and 14 nonscalable fonts (mostly variations of Courier) for portrait and landscape modes. Adobe PostScript Level 2 (\$479.95) and a PostScript fax card (\$299) are optional.

► **Panasonic SideWriter KX-P4400.** List price: \$699; 1MB RAM upgrade, \$149; 2MB RAM upgrade, \$225; 4MB RAM upgrade, \$399; PostScript upgrade, \$479.95; RS-232C serial interface, \$109.95 (requires PostScript upgrade); AppleTalk interface, \$199.95 (requires PostScript upgrade); PostScript fax board, \$299 (requires PostScript upgrade and 2MB RAM upgrade); drum unit, \$156; toner kit, \$14.95. Panasonic Communications & Systems Co., 2 Panasonic Way, Secau-

cus, NJ 07094; 800-742-8086.

Circle 478 on reader service card

QMS Inc.

• QMS 1060 Print System • QMS magicolor

BY BRUCE BROWN AND

STEVEN C.M. CHEN

QMS offers two versatile workgroup printers, the 600-dot-per-inch monochrome QMS 1060 Print System and the QMS magicolor—one of the first 600-dpi color laser printers on the market. Both feature QMS's Crown architecture, which



QMS magicolor

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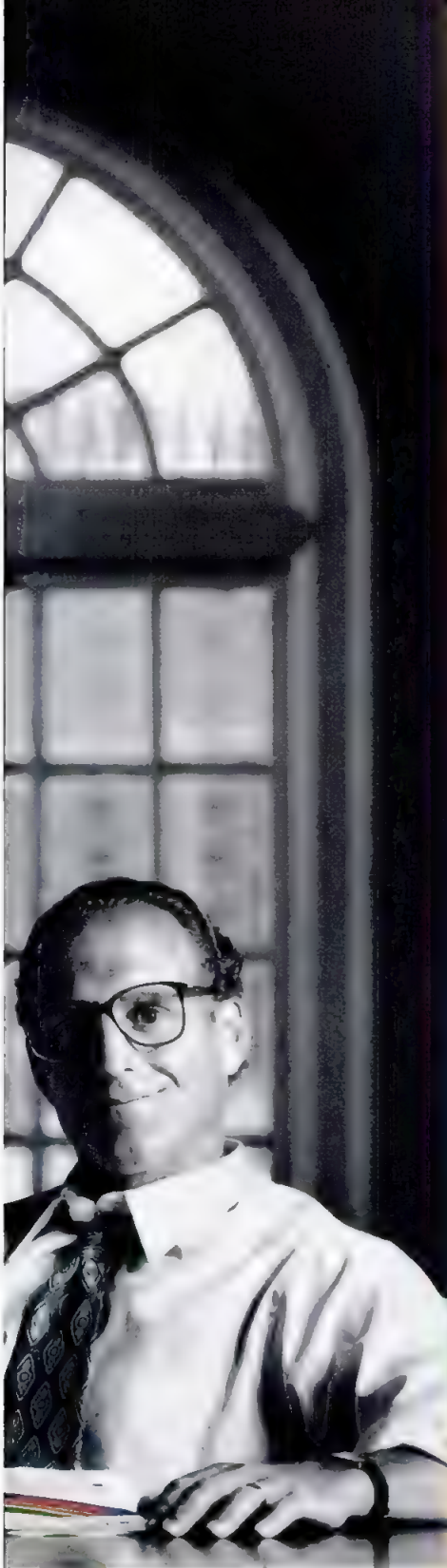
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CIRCLE 282 ON READER SERVICE CARD



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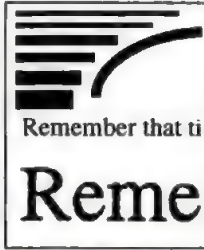
**HEWLETT
PACKARD**

Apple LaserWriter Select 360

\$1,599

10-ppm laser printer (Fuji Xerox P1 engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5

PCL Text Speed: 7.2 ppm
PCL Graphics Speed: 2.2 gppm
PS Text Speed: 8.4 ppm
PS Graphics Speed: 1.0 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 3.6 ppm
Lotus 1-2-3 for Windows: 2.0 gppm
CorelDRAW: 1.7 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 7.8 gppm
Lotus 1-2-3 for Windows: 2.0 gppm
CorelDRAW: 1.1 gppm

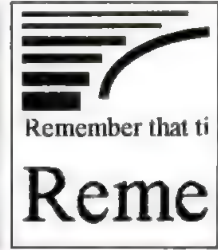


C. Itoh CI-44 Little Laser

\$599

4-ppm laser printer (TEC LB-1000 engine) with 300-dpi output, GDI, Adobe PostScript Level 1 (optional), PCL 4 (optional)

PCL Text Speed: 1.1 ppm
PCL Graphics Speed: 0.4 gppm
PS Text Speed: 1.8 ppm
PS Graphics Speed: 0.3
GDI WINDOWS APPLICATIONS:
Word for Windows: 2.7 ppm
Lotus 1-2-3 for Windows: 2.2 gppm
CorelDRAW: 1.5 gppm

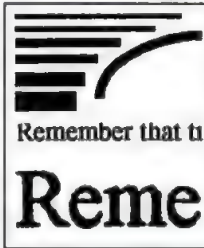


Brother HL-630

\$499

6-ppm laser printer (Brother HL-630 engine) with 300-dpi output, PCL 4

PCL Text Speed: 6.0 ppm
PCL Graphics Speed: 2.6 gppm
PS Text Speed: N/A
PS Graphics Speed: N/A
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.1 ppm
Lotus 1-2-3 for Windows: 3.3 gppm
CorelDRAW: 1.9 gppm



C. Itoh ProWriter CI-6Xtra

\$1,799

8-ppm laser printer (TEC 1323 engine) with 600-dpi output GDI, PCL 5

PCL Text Speed: 7.1 ppm
PCL Graphics Speed: 2.0 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.4 ppm
Lotus 1-2-3 for Windows: 1.7 gppm
CorelDRAW: 1.6 gppm
GDI WINDOWS APPLICATIONS:
Word for Windows: 3.2 ppm
Lotus 1-2-3 for Windows: 2.5 gppm
CorelDRAW: 1.9 gppm



Canon LBP-430

\$799

4-ppm laser printer (Canon LBP-PX engine) with 300-dpi output, PCL 5

PCL Text Speed: 3.4 ppm
PCL Graphics Speed: 1.2 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 3.7 ppm
Lotus 1-2-3 for Windows: 1.1 gppm
CorelDRAW: 1.0 gppm



C. Itoh ProWriter CI-6Xtra+

\$2,099

8-ppm laser printer (TEC 1323 engine) with 600-dpi output, GDI, PostScript Level 2 clone, PCL 5

PCL Text Speed: 7.2 ppm
PCL Graphics Speed: 2.1 gppm
PS Text Speed: 8.3 ppm
PS Graphics Speed: 0.3 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 2.9 gppm
Lotus 1-2-3 for Windows: 0.9 gppm
CorelDRAW: 0.3 gppm
GDI WINDOWS APPLICATIONS:
Word for Windows: 0.3 ppm
Lotus 1-2-3 for Windows: 2.6 gppm
CorelDRAW: 1.9 gppm



Canon LBP-860

\$1,839

8-ppm laser printer (Canon LBP-EX engine) with 600-dpi output, Adobe Level 2 (optional), PCL 5e

PCL Text Speed: 8.0 ppm
PCL Graphics Speed: 1.6 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.9 ppm
Lotus 1-2-3 for Windows: 2.5 gppm
CorelDRAW: 1.8 gppm

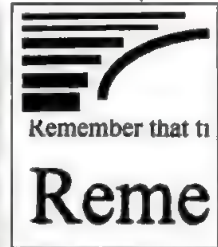


C. Itoh ProWriter CI-6XA

\$2,299

8-ppm laser printer (TEC 1323 engine) with 600-dpi output GDI, PostScript Level 2 clone, PCL 5

PCL Text Speed: 7.2 ppm
PCL Graphics Speed: 2.0 gppm
PS Text Speed: 5.6 ppm
PS Graphics Speed: 0.3 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 2.9 gppm
Lotus 1-2-3 for Windows: 0.9 gppm
CorelDRAW: 0.3 gppm
GDI WINDOWS APPLICATIONS:
Word for Windows: 3.3 ppm
Lotus 1-2-3 for Windows: 2.9 gppm
CorelDRAW: 1.7 gppm





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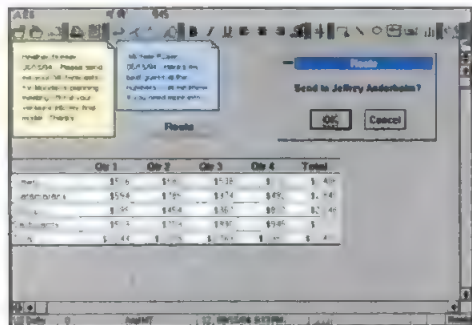
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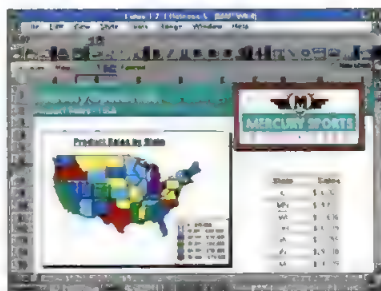
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One-Step Charting lets you build a chart complete with labels, titles and legends, all in a single step.

Drag-and-Fill fills in ranges from other documents in just one step. And our improved OLE 2.0 Drag-and-Drop lets you move copy or data across worksheets or files fast.

Multi-page Print Preview lets you view up to nine spreadsheets on your screen before you print.

Taken all together, the new 1-2-3 is loaded with enhancements that make getting the job done a whole lot easier—alone or in a workgroup. And 1-2-3 Release 5 gives you the best compatibility with 1-2-3 for DOS of any spreadsheet. To learn more about 1-2-3 Release 5, visit your Lotus



1-2-3 Release 5 features Lotus Maps. It's the easiest, most effective way to analyze your spreadsheet data geographically.

Authorized Reseller or call **1-800-TRADE-UP, ext. A227*** for a free demo disk. A 1-2-3 upgrade costs \$119.**

Lotus
Working Together™

NEW SMARTSUITE 3.0. A MAJOR RELEASE TO HELP YOU AND YOUR TEAM WORK TOGETHER.

To work better people need powerful desktop applications, built for both individual and team productivity.

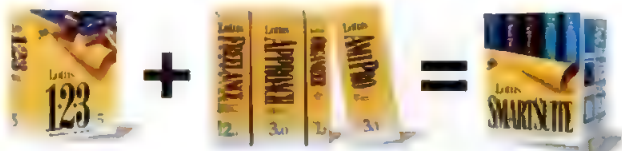
SmartSuite® 3.0 is exactly that. It's the best suite for

this new way of working because it's the

only suite built to optimize
Lotus Notes.

The applications that make up
SmartSuite have been upgraded
in some very important ways—so they work
harder and work together better than ever.

1-2-3 Release 5 is packed with new
features like SmartMasters spreadsheets
templates, Lotus Maps for geographic
visuals of data, Smart Assistants to guide you, seamless
integration with Approach database, Range Routing for



mailing spreadsheet ranges, OLE 2.0 Drag-and-Drop, and,
of course, Lotus Notes Integration.

The new Lotus Approach 3.0 offers unprecedented
ease-of-use, PowerClick™ reporting, X10™ technology
(our new, exclusive, speed-optimized architecture) and
the easiest-to-design forms, mailing labels and cross-
tabs on the market.

Lotus Ami Pro® offers powerfully fast word processing
(49% faster than Word, 103% faster than WordPerfect®),
low memory/hard disk requirements (4MB RAM, 19MB
for complete installation), with proofing tools, collapsible
click-and-drag outlining, revision marking, powerful
macro language and automatic list renumbering.
There are over 55 predesigned style sheets
for memos, faxes, reports and more.
Built-in charting & in-context

drawing tools. Ami Pro also seamlessly imports docu-
ments from other word processors.

Freelance Graphics® 2.1 features task and industry

specific SmartMasters, a unique 3-step
process to create presentations, charting
and drawing, presentation management
and improved import/export capabilities.

And Organizer™ 1.1 offers easy linking
for cross-referencing, flexible printing,
group scheduling and nifty integration with
Ami Pro so you can create monthly calendars
in Ami Pro from Organizer appointments.

SMARTSUITE 3.0 IS A BETTER INTEGRATED SUITE ACROSS THE BOARD.

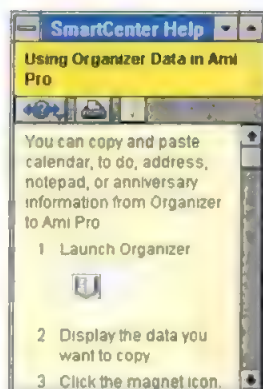
The integration in SmartSuite begins with a consis-
tent look and feel across applications—they share a
common user interface, menus, SmartIcons® and
a Live Status Bar.

SmartCenter, the head-
quarters for cross-applica-
tion services, is always there
to help you switch or launch
applications. You can customize its icon palette into
the configuration that's most convenient for you.

SuiteAnswers are cross-application help tools which
include a SmartSuite Guided Tour and task-oriented Help
Cards—plus the new ScreenCam™ for creating audio/visual
"screen movies." It's the only help service in Windows™
that stays up as you move between applications.

Smart Assistants are your step-by-step guide through
common tasks.

And our powerful 1-2-3/Approach
database integration lets you analyze
and format 1-2-3 data, taking full
advantage of Approach's easy-to-use



Help Card, one of SmartSuite's
powerful help tools, guides you
through cross-application tasks.



SmartCenter is
always there
to help you
launch appli-
cations or switch
between them. And Bubble Help is
right there for you—all you do is point.

SuiteAnswers
menu



forms and reports,
dynamic crosstabs to
pivot rows and columns
and tools for creating summaries

or viewing data in several formats.

**SMARTSUITE, THE NOTESREADY
SUITE, EXTENDS THE DESKTOP
TO THE WORKGROUP.**

SmartSuite 3.0 includes powerful workgroup enhancements. But for an even higher level of workgroup capability, just add Lotus Notes and see what happens:

Combined with Lotus Notes, 1-2-3 Release 5 becomes a model management system that lets team members search a library of worksheets.

Add Notes to Ami Pro 3.1 and it becomes a real "workgroup processor." Use the built-in Notes database for efficient, secure document sharing and tracking. And you can format your Notes or cc:Mail® messages directly in Ami Pro.

Approach 3.0, the top-rated Windows database, becomes a shared reporting, forms and analysis tool. Its advanced integration with Lotus Notes lets you build sophisticated, information-intensive workgroup applications and join Notes data to other types of databases, from dBASE to SQL.

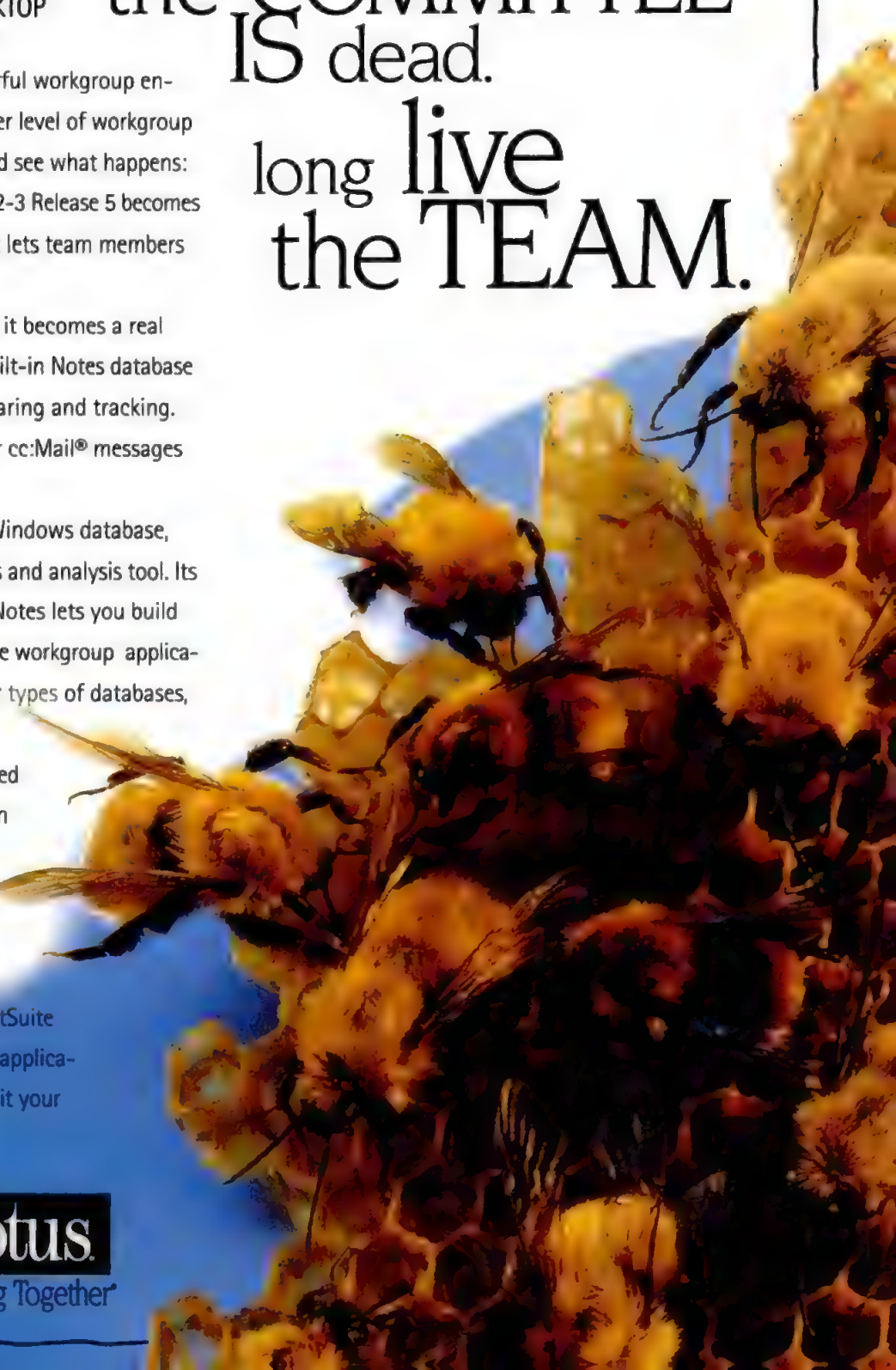
And Freelance Graphics 2.1, used with Notes, becomes a presentation storage system, a library of past presentations, which a team can browse and pull from to create new ones.

For more information on SmartSuite Release 3.0 and each of the 5 top applications that make up SmartSuite, visit your

Lotus Authorized Reseller or for a comprehensive multimedia overview call 1-800-TRADE-UP, ext. A228* for the free Lotus Product Gallery CD. A SmartSuite upgrade costs \$299.**



the COMMITTEE
IS dead.
long live
the TEAM.



Lotus
Working Together

SMARTSUITE 3.0

SmartCenter
(to move between applications)

SmartMasters
(for predesigned templates)

Fast Format
(apply styles throughout documents)

ScreenCam
(to put your ideas in motion)

Smart Assistants
(to guide you)



Configurable Single Install
(for easy one-step installation)

Small Footprint On Your PC
(the most efficient suite available)

1-2-3/Approach Integration
(database power in your spreadsheet)



1-2-3 RELEASE 5 SPREADSHEET



SmartMasters
(useful predesigned templates)

Lotus Maps
(geographic visuals of data)

Lotus Approach Integration
(for extra database power)

Smart Assistants
(to guide you)

Range Routing
(for mailing spreadsheet ranges)

Direct Access To
Database Files
(open dBASE and Paradox® files directly into 1-2-3)

OLE 2.0 Drag-And-Drop
(move or copy data, with visual mouse cues)

APPROACH 3.0 DATABASE



PowerClick Reportwriter
(for wysiwyg design)

Smart Assistants
(to guide you)

InfoBox
(instant on-screen manipulation)

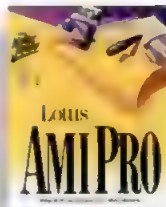
X10 Speed Architecture
(for blazing speed)

Lotus 1-2-3 Integration
(for working with 1-2-3)

PowerKey™ Technology
(for direct access to existing data)

Dynamic Crosstabs
(for drag-and-drop analysis)

AMI PRO 3.1 WORD PROCESSOR



New Proofing Tools
(for easy document proofing)

Collapsible Click-And-Drag Outlining
(simplifies organization)

Revision Marking
(edit documents without confusion)

New Style Sheets
(more professionally designed templates than ever)

Text Styling
(make your e-mail look better)

WordPerfect Switchkit®
(the move from DOS is painless)

Stick-It Notes
(add comments and messages)

FREELANCE GRAPHICS 2.1 PRESENTATION GRAPHICS



Unique Three-Step Process
(for quick and easy presentations)

One-Click Charting
(access a library of charts and drawings with one click)

Page Sorter
(presentation management at a glance—review and rearrange with ease)

Import/Export
(more file formats than ever—including Harvard/DOS and PowerPoint® 3.0)

ORGANIZER 1.1 PERSONAL INFORMATION MANAGER



Easy Linking
(makes cross-referencing simple)

Flexible Printing
(for your manual planner, mailing labels from your address book)

Group Scheduling
(use with cc:Mail to set up meetings with anyone on your WAN or LAN)

Real Time Access
(instantly view co-workers' busy and free time)

how the NEW SMARTSUITE 3.0 HELPS workgroups work.

The new SmartSuite 3.0. Featuring major new releases of 1-2-3, Ami Pro, Approach database and Freelance Graphics—plus the popular and powerful personal information manager Organizer—this is the ultimate integration of your most important desktop tools. For more information on SmartSuite Release 3.0 and each of the 5 top applications that make up SmartSuite, visit your Lotus Authorized Reseller or for a comprehensive multimedia overview call 1-800-TRADE-UP, ext. A228* for the free Lotus Product Gallery CD. A SmartSuite upgrade costs \$299.††



*In Canada call 1-800-60-LOTUS. **\$119 qualified upgrade price direct from Lotus. *NSTL, May 1994. †\$299 promotional price available while supplies last. ©1994 Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142. Lotus, Lotus Notes, 1-2-3, Approach, Ami Pro, cc:Mail, Freelance Graphics, SmartSuite, SmartIcons and Working Together are registered trademarks and ScreenCam, PowerClick, Notes/FX, Version Manager, SmartMasters, Organizer, PowerKey, X10 and NotesReady are trademarks of Lotus Development Corporation. WordPerfect and Switchkit are registered trademarks of WordPerfect Corporation. PowerPoint is a registered trademark and Windows is a trademark of Microsoft Corporation. Paradox is a registered trademark of Borland International, Inc.

DEClaser 1800

\$779

6-ppm laser printer (Minolta SP-6HX engine) with 300-dpi output, PCL 5

PCL Text Speed: 6.2 ppm
PCL Graphics Speed: 2.3 ppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.5 ppm
Lotus 1-2-3 for Windows: 2.4 gppm
CorelDRAW: 1.5 gppm



HP LaserJet 4P

\$1,229

4-ppm laser printer (Canon PX2 engine) with 600-dpi output, Adobe PostScript Level 2 (optional), PCL 5e

PCL Text Speed: 3.9 ppm
PCL Graphics Speed: 1.3 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 3.5 ppm
Lotus 1-2-3 for Windows: 1.5 gppm
CorelDRAW: 1.2 gppm



DEClaser 5100

\$1,599

8-ppm laser printer (Canon LBP-EX engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5e

PCL Text Speed: 8.1 ppm
PCL Graphics Speed: 1.2 gppm
PS Text Speed: 8.1 ppm
PS Graphics Speed: 1.2 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.6 ppm
Lotus 1-2-3 for Windows: 2.6 gppm
CorelDRAW: 1.8 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 6.3 gppm
Lotus 1-2-3 for Windows: 1.8 gppm
CorelDRAW: 1.8 gppm

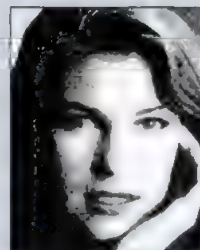


HP LaserJet 4 Plus

\$1,839

12-ppm laser printer (Canon EX engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5e

PCL Text Speed: 11.5 ppm
PCL Graphics Speed: 2.8 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 9.7 ppm
Lotus 1-2-3 for Windows: 3.3 gppm
CorelDRAW: 1.8 gppm



Epson ActionLaser 1600

\$1,199

6-ppm laser printer (Minolta SP-6XH engine) with 600-dpi output, PostScript Level 2 clone (optional), PCL 5e

PCL Text Speed: 6.2 ppm
PCL Graphics Speed: 2.3 ppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.9 ppm
Lotus 1-2-3 for Windows: 2.9 gppm
CorelDRAW: 1.9 gppm



HP LaserJet 4M Plus

\$2,479

12-ppm laser printer (Canon EX engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5e

PCL Text Speed: 11.3 ppm
PCL Graphics Speed: 2.8 gppm
PS Text Speed: 11.3 ppm
PS Graphics Speed: 1.5 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 10.0 ppm
Lotus 1-2-3 for Windows: 3.3 gppm
CorelDRAW: 1.9 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 9.8 gppm
Lotus 1-2-3 for Windows: 2.8 gppm
CorelDRAW: 1.5 gppm



HP LaserJet 4L

\$849

4-ppm laser printer (Canon PX engine) with 300-dpi output, PCL 5

PCL Text Speed: 4.0 ppm
PCL Graphics Speed: 1.3 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 3.4 ppm
Lotus 1-2-3 for Windows: 1.9 gppm
CorelDRAW: 1.1 gppm

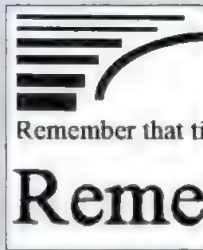


HP Color LaserJet

\$7,295

10-ppm B-size color laser printer (proprietary Konica engine) with 300-dpi output, Adobe PostScript Level 2 (optional), enhanced PCL 5

PCL Text Speed: 8.6 ppm
PCL Graphics Speed: 8.6 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 6.8 ppm
Lotus 1-2-3 for Windows: 2.3 gppm
CorelDRAW: 1.3 gppm

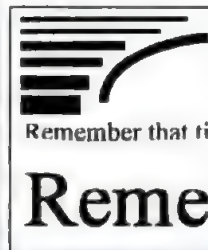


Lexmark IBM LaserPrinter 4037 SE**\$799****5-ppm LED printer (Lexmark 4037 engine) with 300-dpi output, PCL 4**

PCL Text Speed: 4.7 ppm
 PCL Graphics Speed: 1.5 gppm
PCL WINDOWS APPLICATIONS:
 Word for Windows: 4.7 ppm
 Lotus 1-2-3 for Windows: 2.0 gppm
 CorelDRAW: 1.2 gppm

**Mannesmann Tally T9008****\$1,499****8-ppm laser printer (TEC LB 3500 engine) with 600-dpi output, PostScript Level 2 clone (optional), PCL 5e**

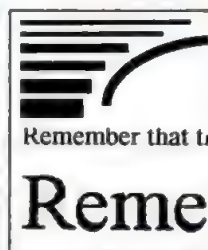
PCL Text Speed: 7.9 ppm
 PCL Graphics Speed: 2.3 gppm
PCL WINDOWS APPLICATIONS:
 Word for Windows: 7.1 ppm
 Lotus 1-2-3 for Windows: 2.8 gppm
 CorelDRAW: 1.6 gppm

**Lexmark Winwriter 600****\$1,199****8-ppm laser printer (Lexmark 4029 engine) with 600-dpi output, PCL 4**

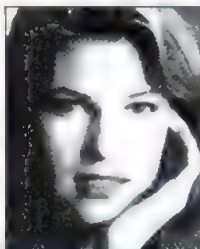
PCL Text Speed: 9.0 ppm
 PCL Graphics Speed: 2.3 gppm
PCL WINDOWS APPLICATIONS:
 Word for Windows: 5.6 ppm
 Lotus 1-2-3 for Windows: 2.1 gppm
 CorelDRAW: 1.0 gppm
GDI WINDOWS APPLICATIONS:
 Word for Windows: 7.9 ppm
 Lotus 1-2-3 for Windows: 2.7 gppm
 CorelDRAW: 1.3 gppm

**Okidata OL400e****\$699****4-ppm LED printer (OKI OL400e engine) with 300-dpi output, PCL 4.5**

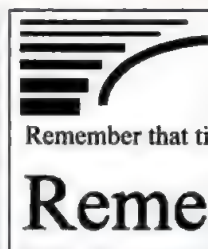
PCL Text Speed: 4.1 ppm
 PCL Graphics Speed: 1.6 gppm
PCL WINDOWS APPLICATIONS:
 Word for Windows: 3.8 ppm
 Lotus 1-2-3 for Windows: 2.2 gppm
 CorelDRAW: 0.9 gppm

**Lexmark IBM LaserPrinter 4039 12R Plus****\$1,749****12-ppm laser printer (Lexmark 4039 engine) with 600-dpi output, GDI, PostScript Level 2 clone, PCL 5e**

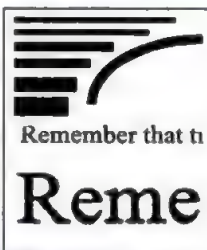
PCL Text Speed: 10.7 ppm
 PCL Graphics Speed: 2.7 gppm
 PS Text Speed: 10.9 ppm
 PS Graphics Speed: 1.4 gppm
PCL WINDOWS APPLICATIONS:
 Word for Windows: 9.9 ppm
 Lotus 1-2-3 for Windows: 4.0 gppm
 CorelDRAW: 1.7 gppm
PS WINDOWS APPLICATIONS:
 Word for Windows: 9.8 gppm
 Lotus 1-2-3 for Windows: 2.3 gppm
 CorelDRAW: 1.2 gppm

**Okidata OL410e****\$899****4-ppm LED printer (OKI OL400e engine) with 300-dpi output, PCL 5**

PCL Text Speed: 4.0 ppm
 PCL Graphics Speed: 1.8 gppm
PCL WINDOWS APPLICATIONS:
 Word for Windows: 3.8 ppm
 Lotus 1-2-3 for Windows: 1.7 gppm
 CorelDRAW: 1.1 gppm

**Lexmark IBM LaserPrinter 4039 12L Plus****\$2,299****12-ppm laser printer (Lexmark 4039 engine) with 600-dpi output, GDI PostScript Level 2 clone, PCL 5e**

PCL Text Speed: 10.7 ppm
 PCL Graphics Speed: 2.7 gppm
 PS Text Speed: 10.5 ppm
 PS Graphics Speed: 1.3 gppm
PCL WINDOWS APPLICATIONS:
 Word for Windows: 9.8 ppm
 Lotus 1-2-3 for Windows: 3.4 gppm
 CorelDRAW: 1.9 gppm
PS WINDOWS APPLICATIONS:
 Word for Windows: 8.7 ppm
 Lotus 1-2-3 for Windows: 2.2 gppm
 CorelDRAW: 1.2 gppm

**Panasonic SideWriter KX-P4400****\$699****4-ppm LED printer (Matsushita 4400 engine) with 300-dpi output, Adobe PostScript Level 2 (optional), PCL 4**

PCL Text Speed: 4.2 ppm
 PCL Graphics Speed: 1.3 gppm
PCL WINDOWS APPLICATIONS:
 Word for Windows: 3.8 ppm
 Lotus 1-2-3 for Windows: 1.1 gppm
 CorelDRAW: 0.8 gppm



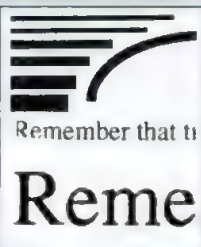
COVER STORY
Personal/Workgroup Lasers

QMS 1060 Print System

\$2,699

10-ppm laser printer (proprietary engine) with 600-dpi output, PostScript Level 2 clone, PCL 5

PCL Text Speed: 9.7 ppm
PCL Graphics Speed: 3.0 gppm
PS Text Speed: 6.1 ppm
PS Graphics Speed: 1.4 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 8.7 ppm
Lotus 1-2-3 for Windows: 3.0 gppm
CorelDRAW: 2.0 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 8.7 ppm
Lotus 1-2-3 for Windows: 3.0 gppm
CorelDRAW: 1.6 gppm



Sharp JX-9660PS

\$1,499

8-ppm laser printer (Sharp JX-9660 engine) with 600-dpi output, PostScript Level 1 clone, PCL 5

PCL Text Speed: 8.2 ppm
PCL Graphics Speed: 1.1 gppm
PS Text Speed: 8.1 ppm
PS Graphics Speed: 0.8 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 7.3 ppm
Lotus 1-2-3 for Windows: 2.0 gppm
CorelDRAW: 1.3 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 6.9 gppm
Lotus 1-2-3 for Windows: 1.6 gppm
CorelDRAW: 0.7 gppm



QMS magicolor

\$9,999

8-ppm color laser printer with 600-dpi output (requires memory upgrade), PostScript Level 2 clone, PCL 5C

PCL Text Speed: 6.8 ppm
PCL Graphics Speed: 1.4 gppm
PS Text Speed: 6.6 ppm
PS Graphics Speed: 0.9 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.4 ppm
Lotus 1-2-3 for Windows: 2.0 gppm
CorelDRAW: 0.9 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 5.2 gppm
Lotus 1-2-3 for Windows: 1.1 gppm
CorelDRAW: 0.9 gppm



TI microWriter PS23

\$799

5-ppm LED printer (Samsung SL 1050 engine) with 300-dpi output, Adobe PostScript Level 1, PCL 4

PCL Text Speed: 4.6 ppm
PCL Graphics Speed: 1.1 gppm
PS Text Speed: 4.5 ppm
PS Graphics Speed: 0.5 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 4.2 ppm
Lotus 1-2-3 for Windows: 1.1 gppm
CorelDRAW: 0.6 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 3.3 gppm
Lotus 1-2-3 for Windows: 0.6 gppm
CorelDRAW: 0.5 gppm



Sharp JX-9400H

\$599

8-ppm laser printer (Sharp JX-9400 engine) with 300-dpi output, PCL 4

PCL Text Speed: 8.0 ppm
PCL Graphics Speed: 1.2 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.5 ppm
Lotus 1-2-3 for Windows: 1.0 gppm
CorelDRAW: 0.9 gppm

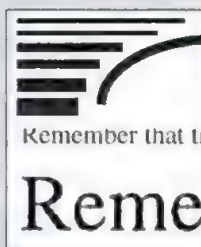


TI microLaser 600

\$999

5-ppm laser printer (Samsung SL 2050 engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5

PCL Text Speed: 4.6 ppm
PCL Graphics Speed: 1.5 gppm
PS Text Speed: 4.5 ppm
PS Graphics Speed: 1.0 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 3.0 ppm
Lotus 1-2-3 for Windows: 1.3 gppm
CorelDRAW: 1.1 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 4.2 gppm
Lotus 1-2-3 for Windows: 1.1 gppm
CorelDRAW: 1.1 gppm



Sharp JX-9460PS

\$849

6-ppm laser printer (Sharp 9460 engine) with 600-dpi output, PostScript Level 1 clone, PCL 5

PCL Text Speed: 6.0 ppm
PCL Graphics Speed: 0.5 gppm
PS Text Speed: 6.0 ppm
PS Graphics Speed: 0.8 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 6.3 ppm
Lotus 1-2-3 for Windows: 2.6 gppm
CorelDRAW: 0.7 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 5.9 gppm
Lotus 1-2-3 for Windows: 1.7 gppm
CorelDRAW: 0.8 gppm



TI microLaser Pro 600 PS23

\$1,599

8-ppm laser printer (Sharp JX-9600 engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5

PCL Text Speed: 3.6 ppm
PCL Graphics Speed: 1.1 gppm
PS Text Speed: 8.1 ppm
PS Graphics Speed: 1.1 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 3.1 ppm
Lotus 1-2-3 for Windows: 2.4 gppm
CorelDRAW: 1.6 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: N/A
Lotus 1-2-3 for Windows: N/A
CorelDRAW: N/A



COVER STORY
Personal/Workgroup Lasers

TI microLaser Power Pro

\$1,899

12-ppm laser printer (Sharp JX-9612 engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5

PCL Text Speed: 12.1 ppm
PCL Graphics Speed: 4.4 gppm
PS Text Speed: 12 gppm
PS Graphics Speed: 1.7 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 7.0 ppm
Lotus 1-2-3 for Windows: 1.6 gppm
CorelDRAW: 1.9 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 9.1 gppm
Lotus 1-2-3 for Windows: 1.7 gppm
CorelDRAW: 1.3 gppm



Xerox 4505ps

\$1,629

5-ppm laser printer (Fuji Xerox XP-5 engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5e

PCL Text Speed: 4.9 ppm
PCL Graphics Speed: 1.5 gppm
PS Text Speed: 4.9 ppm
PS Graphics Speed: 0.9 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 4.5 ppm
Lotus 1-2-3 for Windows: 1.8 gppm
CorelDRAW: 1.3 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 4.1 gppm
Lotus 1-2-3 for Windows: 1.1 gppm
CorelDRAW: 0.8 gppm



Unilex AP312 Plus

\$1,895

12-ppm laser printer (Lexmark 4039 engine) with 600-dpi output, PostScript Level 2 clone, PCL 5e

PCL Text Speed: 11.1 ppm
PCL Graphics Speed: 2.7 gppm
PS Text Speed: 10.6 ppm
PS Graphics Speed: 1.5 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 9.1 ppm
Lotus 1-2-3 for Windows: 3.5 gppm
CorelDRAW: 1.5 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 8.3 gppm
Lotus 1-2-3 for Windows: 2.1 gppm
CorelDRAW: 1.2 gppm



Xerox 4510ps

\$2,379

10-ppm laser printer (Fuji Xerox XP-10 engine) with 600-dpi output, Adobe PostScript Level 2, PCL 5e

PCL Text Speed: 9.7 ppm
PCL Graphics Speed: 2.7 gppm
PS Text Speed: 9.5 ppm
PS Graphics Speed: 1.4 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 8.7 ppm
Lotus 1-2-3 for Windows: 3.4 gppm
CorelDRAW: 1.7 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 6.3 gppm
Lotus 1-2-3 for Windows: 2.6 gppm
CorelDRAW: 1.1 gppm



can simultaneously process multiple jobs with multiple emulations from multiple ports. Optional RISC-based network interface cards can switch among multiple network protocols. Remote management utilities are planned but were not available at the time of review.

The 10-page-per-minute QMS 1060 comes with 8 MB of RAM for \$2,699 list (expandable to 64MB), a 500-sheet standard paper cassette, and a 150-sheet multi-purpose cassette that supports up to legal-size paper as well as transparencies and No. 10 envelopes. PostScript output at 600 dpi is excellent, with crisp text and subtle gray scaling. Performance was above average for both text and graphics.

With a list price of \$9,999, the magicolor, rated at 8 monochrome ppm and 2 color ppm, offers 600-dpi PostScript (using QMS's PostScript clone) and 300-dpi PCL 5C printing in both monochrome and color.

The magicolor's plain-paper color output showed more banding and graininess than most thermal wax printers, but it definitely outclassed that of the HP Color LaserJet. At 300 by 300 dpi, its color output was equivalent to the Xerox 4900 Color

Laser Printer's 1,200-by-300 output. Colors were bright and fully saturated, and color registration was more accurate than that of the 4900. At default settings the magicolor's 600-by-600 output (which requires 28MB for an extra \$1,000) was too dark, but a little tweaking of color settings can produce dramatically better results. Price per printout for 5 percent coverage of each color (20 percent total) is 20 cents, compared to the 4900's 23 cents and the Color LaserJet's 10.7.

The Hitachi SL-Σ laser engine, with its 33-MHz Intel 80960CF RISC processor, showed respectable performance, printing text at 6.8 ppm in PCL 5 and 6.6 ppm in PostScript. Monochrome graphics speed was average at 1.4 graphics pages per minute in PCL 5 at 300 dpi and 0.9 gppm in PostScript, in both 300 and 600 dpi.

► **QMS 1060 Print System.** List price:

Xerox 4900 Color Laser Printer

\$8,495

12-ppm color laser printer (Hitachi color engine) with 1,200-by-300-dpi output*, Adobe PostScript Level 2, PCL 5

PCL Text Speed: 8.2 ppm
PCL Graphics Speed: 1.6 gppm
PS Text Speed: 7.1 ppm
PS Graphics Speed: 0.6 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.7 ppm
Lotus 1-2-3 for Windows: 1.6 gppm
CorelDRAW: 0.9 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 6.2 gppm
Lotus 1-2-3 for Windows: 1.3 gppm
CorelDRAW: 0.7 gppm



*Requires memory upgrade



\$2,699; 4MB SIMM, \$299; 8MB SIMM, \$599; paper cassettes (letter-, legal-, A4-size), 50-envelope cassette, \$129 each; 500-page paper feeder, \$289; IDE/SCSI adapter board, \$199; 45MB external hard disk, \$999; CrownNet Ethernet card, \$799; CrownNet Token-Ring card, \$899; toner/developer/drum unit, \$159. **QMS magicolor.** List price: \$9,999; 4MB RAM, \$299; 8MB RAM, \$599; 16MB RAM, \$1,299; 32MB RAM, \$2,699; 45MB external hard disk, \$999; 250-sheet lower sheet feeder, \$625; 250-sheet universal paper cassette, \$129; LNO3 emulation, \$495;

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COVER STORY

Personal/Workgroup Lasers

CCITT Group IV cartridge, \$295; HP Pro Collection font cartridge, \$295; DECnet interface kit, \$999; CrownNet Ethernet card, \$799; CrownNet Token-Ring card, \$899; 4,000-page black toner cartridge, \$60; 2,000-page cyan, magenta, and yellow toner cartridges, \$80 each; 30,000-page black developer, \$175; 15,000-page cyan, magenta, and yellow developers, \$180 each; OPC cartridge, \$305; 3,000-page fuser oil kit, \$35; 6,000-page toner waste box pack, \$12.50. QMS Inc., P.O. Box 81250, Mobile, AL 36689; 800-523-2696, 205-633-4300; fax, 205-633-5013.

Circle 479 on reader service card

Sharp Electronics Corp.



EDITORS' CHOICE

Sharp JX-9400H

- Sharp JX-9460PS
- Sharp JX-9660PS

BY EDWARD MENDELSON

With their 600-dot-per-inch PhoenixPage PostScript-compatible output, Sharp's 8-page-per-minute JX-9660PS and 6-ppm

JX-9460PS are designed for small businesses that want high-quality printing at a low cost. At 2MB, desktop publishers may find them a little underpowered; we had to add a \$457 4MB memory board in order to complete our Graphics Speed test.

The JX-9660PS (\$1,499 list, \$1,200 street), comes with two 250-sheet paper cassettes. Its slower sibling, the single-cassette JX-9460PS, lists for \$849 (\$799 street). Small offices will like both models' built-in PCL 5 emulation, paper trays that pop out at the touch of a button, and automatic Energy Star-compliant sleep mode.

For buyers who do not insist on PostScript, Sharp's new spectacularly priced laser printer, the \$599 JX-9400H (\$549 street) offers 8-ppm, 300-dpi, PCL 4 emulation in a one-paper-tray unit. The JX-9400H's image quality was typical of models without resolution enhancement.

All three models fill only 1.3 square feet of desk space. Installation is somewhat complex, involving a separate conductor cartridge and toner kit, and we



Sharp JX-9660PS

found the printers' LCD menus a little difficult to navigate.

Text output for both PostScript models was faster than rated: 8.1 ppm for the JX-9660PS and 6.7 ppm for the JX-9460PS. Graphics performance was less impressive: 0.8 graphics pages per minute at 300 dpi, 0.3 gppm at 600 dpi for the JX-9660PS and the JX-9460PS. Graphics output was impressive for its subtle shading. Both models come with the standard 35 PostScript fonts and 27 PCL 5 fonts, and a slot for a proprietary font card lets you add HP-compatible bitmap or scalable fonts. Automatic emulation switching between PostScript and

Model 1465DL - 14" auto-scan,
98-264 VAC, non-glare



Model 1520 - 15" FST, auto-scan,
MPRI II, 98-264 VAC, digital controls



PCL 5 requires at least 3MB in the printer.

The built-in 500-sheet capacity of the JX-9660PS is exceptional for desktop laser printers, and either of the two 250-sheet cassettes can be replaced with a \$70 legal-size or \$157 20-envelope cassette. The same optional cassettes can replace the single 250-sheet cassette in the JX-9460PS and the JX-9400H. In all three models, a manual feed slot handles transparencies and single envelopes.

Desktop publishers may prefer models with resolution enhancement and genuine Adobe PostScript, but business users will find all three Sharp models compact, convenient, and economical.

► **Sharp JX-9400H.** List price: \$599; 2MB RAM upgrade, \$229. **Sharp JX-9460PS.** List price: \$849; 1MB RAM upgrade, \$141; 2MB RAM upgrade, \$229; 4MB RAM upgrade, \$457. **Sharp JX-9660PS.** List price: \$1,499; 1MB RAM upgrade, \$141; 2MB RAM upgrade, \$229. Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430; 800-237-4277, 201-529-8200; fax, 201-529-9637.

Circle 480 on reader service card

Texas Instruments Inc.

- **TI microWriter PS23**
- **TI microLaser 600**
- **TI microLaser Pro 600 PS23**
- **TI microLaser Power Pro**

BY ALFRED POOR

Texas Instruments continues to build competitively priced Adobe PostScript printers that do not skimp on features or performance. This year's selection ranges from a 5-page-per-minute personal laser printer to a 12-ppm workgroup model.

Only the easy-to-operate TI microWriter PS23, the baby of the bunch, uses an LED array instead of a laser for imaging. The 300-dot-per-inch, 5-ppm engine provides crisp, dark text and graphics at above-average speed. PCL 4 comes standard in the base model, which lists at \$599 (\$499 street) with PostScript upgrade options of 23 fonts (\$350) or 65



fonts (\$650).

The TI microLaser 600 (\$999 list, \$899 street) reduces the control panel to one button, and gives over printer configuration and control functions to DOS and Windows utilities. Resolution jumps to 600 dpi in PostScript, sharpening image details and improving gray-scale range. Parallel and AppleTalk connections and PCL 5 and PostScript Level 2 emulations are standard. The under-\$1,000 street price should make this an attractive choice. As we went to press, we learned that the shipping date for the microLaser 600 would be delayed until

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CIRCLE 371 ON READER SERVICE CARD

WHICH *printers* SEE THINGS

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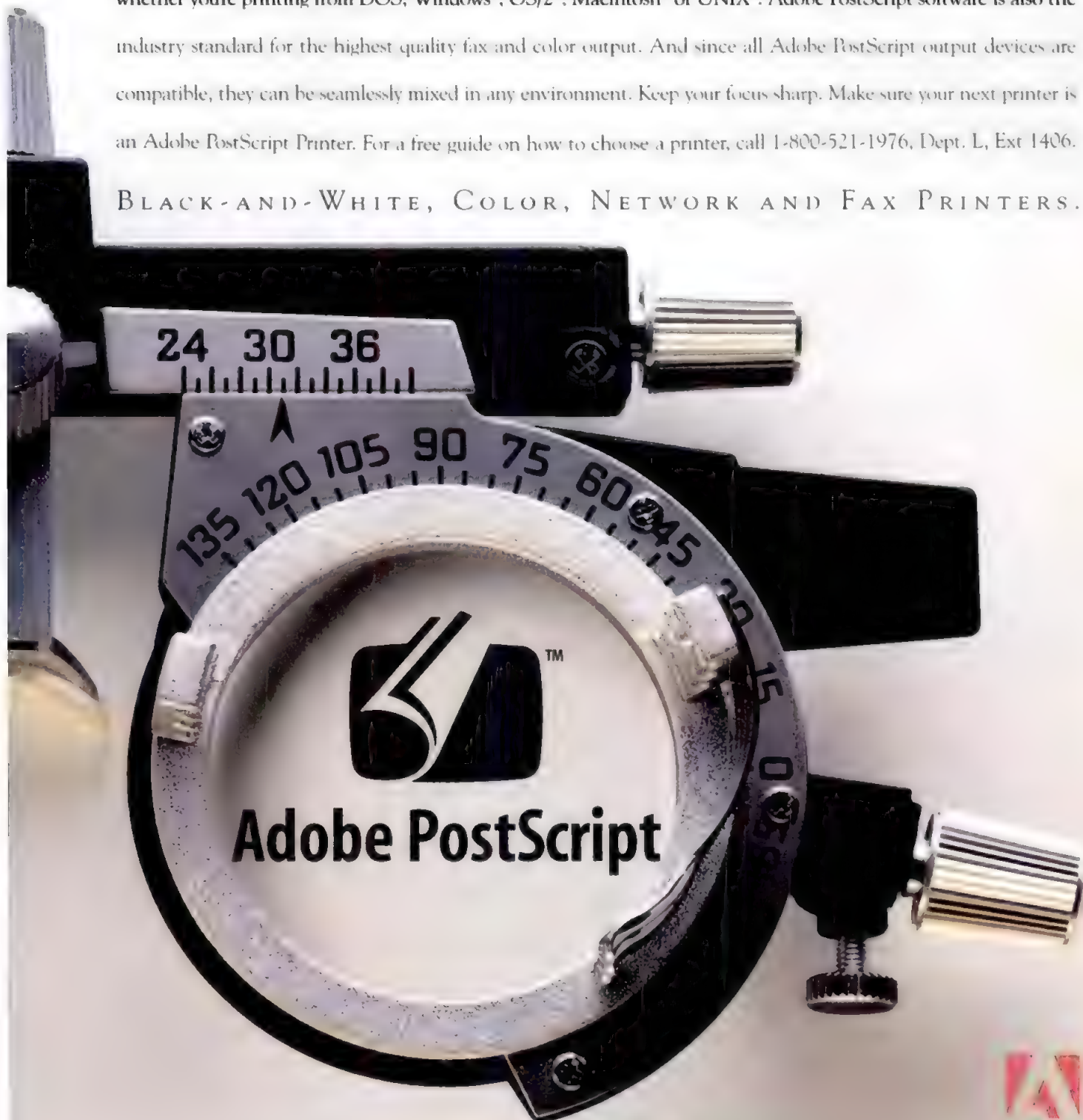
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whether you're printing from DOS, Windows™, OS/2®, Macintosh® or UNIX®. Adobe PostScript software is also the industry standard for the highest quality fax and color output. And since all Adobe PostScript output devices are compatible, they can be seamlessly mixed in any environment. Keep your focus sharp. Make sure your next printer is an Adobe PostScript Printer. For a free guide on how to choose a printer, call 1-800-521-1976, Dept. L, Ext 1406.

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CIRCLE 165 ON READER SERVICE CARD



► **S U M M A R Y O F F E A T U R E S**

Personal/Workgroup Lasers

PC MAGAZINE
EDITORS' CHOICE

In alphabetical order by company

■ = YES □ = NO

	Apple LaserWriter Select 360	Brother HL-630	Canon LBP-430	Canon LBP-850	C. Itoh CI-44 Little Laser	C. Itoh ProWriter CI-8Xtra	C. Itoh ProWriter CI-8Xtra+	C. Itoh ProWriter CI-8XA
List price (base configuration)	\$1,599	\$499	\$799	\$1,839	\$599	\$1,799	\$2,099	\$2,299
Dimensions (HWD, in inches)	8 x 15 x 18.3	7.2 x 14.4 x 14.3	6.1 x 14.5 x 15	12 x 17 x 18	6.9 x 14.1 x 11.3	8.6 x 15.5 x 15.9	8.6 x 15.5 x 15.9	8.6 x 16.6 x 15.9
Weight (pounds)	26	16.8	18	37	11	30.9	30.9	30.9
Engine type/Rated speed (pages per minute)	Laser/10	Laser/8	Laser/4	Laser/8	Laser/4	Laser/8	Laser/8	Laser/8
Engine model	Fuji Xerox P1	Brother HL-630	Canon LBP-PX	Canon LBP-Ex	TEC LB-1000	TEC 1323	TEC 1323	TEC 1323
Processor	16-MHz AMD 29200/16	16-MHz Motorola 68000	16-MHz National Semiconductor NS32CG16/16	20-MHz Intel i960	N/A	16-MHz AMD 29200	16-MHz AMD 29200	16-MHz AMD 29200
Instruction set	RISC	CISC	RISC	RISC	N/A	RISC	RISC	RISC
Standard/maximum RAM	7MB, 16MB	.5MB, 2MB	1MB, 5MB	2MB, 34MB	0, 1MB	4MB, 20MB	4MB, 20MB	4MB, 20MB
Interfaces								
Parallel/serial port	■ ■	■ Optional	■ □	■ ■	■ □	■ Optional	■ Optional	■ □
Bidirectional/ECP parallel support	■ ■	■ □	□ □	□ □	■ □	■ □	■ □	■ □
LocalTalk/SCSI port	■ □	□ □	□ □	■ □	□ □	□ □	□ □	■ □
Automatic interface switching	■	■	□	■	□	■	■	■
Simultaneously active ports	■	■	□	■	□	■	■	■
Paper Handling								
Capacity of each standard cassette (sheets)	250 (letter), 50 (multipurpose)	200 (adjustable; holds sizes from 3 x 5 inches to 8.5 x 14 inches)	100 (multipurpose)	250 (letter), 100 (multipurpose), 75 (envelope)	100 (multipurpose)	250 (multipurpose)	250 (multipurpose)	250 (multipurpose)
Duplexing/Prints on B-size paper	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
Rated maximum paper weight (pounds)	32	38	28	28	20	32	32	32
Fonts and Features								
Automatic emulation switching	■	■	□	■	□	■	■	■
PCL support	PCL 5	PCL 4	PCL 5	PCL 5a	PCL 4 (optional)	PCL 5	PCL 5	PCL 5
Maximum resolution in PCL (dpi)	300 x 300	300 x 300	300 x 300	600 x 600	300 x 300	300 x 300	300 x 300	300 x 300
PostScript support	Adobe Level 2	N/A	N/A	Adobe Level 2 (optional)	Level 1 clone (optional)	N/A	Level 2 clone	Level 2 clone
Maximum resolution in PostScript (dpi)	600 x 600	N/A	N/A	600 x 600	300 x 300	N/A	600 x 600	600 x 600
Number of Type 1 fonts	35	N/A	N/A	N/A	N/A	N/A	35	35
Other emulations	None	Epson FX-850, IBM Proprinter XL	None	None	None	None	None	None
GDI support								
Maximum resolution (dpi)	N/A	300 x 300	N/A	N/A	300 x 300	600 x 600	600 x 600	600 x 600
TrueType rasterizer in firmware	■	□	□	■	□	□	□	■
Resolution enhancement	■	□	■	□	Optional	■	■	■
Network Support								
Internal Ethernet/Token-Ring	□ □	□ □	□ □	□ □	□ □	□ □	□ □	□ □
Remote status messages	□*	□	□	□	□*	□	□	□
Remote paper-tray selection	□	□	□	□	□	□	□	□
Remote configuration/troubleshooting	□* □*	□ □	□ □	□ □	□ □	□ □	□ □	□ □
Remote modification of control panel by end user/administrator	□ □	□ □	□ □	□ □	□* □	□ □	□ □	□ □
Customer Support								
Toll-free technical support	■	■	■	■	■	■	■	■
Telephone support hours (eastern time)	9:00-9:00 M-F	6:00-5:00 M-F	8:00 A.M.- 11:00 P.M. M-F, 11:00-6:00 Sat.	8:00 A.M.- 11:00 P.M. M-F, 11:00-6:00 Sat.	12:00-8:00 P.M. M-F	12:00-8:00 P.M. M-F	12:00-8:00 P.M. M-F	12:00-8:00 P.M. M-F
BBS or on-line service	□	■	■	■	■	■	■	■
Warranty (parts and labor)	1 year	1 year	2 years	2 years	1 year	1 year	1 year	1 year

N/A—Not applicable: The product does not have this feature

* This feature is available in a single-user configuration only

CONTINUES

DEC Laser 1800	DEC Laser 5100	Epson ActionLaser 1500	HP LaserJet 4L	HP LaserJet 4P	HP LaserJet 4 Plus	HP LaserJet 4M Plus
\$779	\$1,599	\$1,199	\$849	\$1,229	\$1,839	\$2,479
8.9 x 14.1 x 17.9	11.7 x 16.4 x 15.9	9 x 14.5 x 18	6.5 x 14.5 x 14	6.8 x 14.7 x 15.4	11.7 x 16.6 x 15.9	11.7 x 16.6 x 15.9
19	37.4	22	18	20	37	37
Laser/6	Laser/8	Laser/6	Laser/4	Laser/4	Laser/12	Laser/12
Minolta SP6X	Canon LBP-EX	Minolta SP-6XH	Canon PX	Canon PXL	Canon EX	Canon EX
16-MHz AMD 29200	20-MHz Intel i960-KA	18-MHz Fujitsu SparcLite MB86930	16-MHz Motorola 68000	25-MHz Intel i960	25-MHz Intel i960	25-MHz Intel i960
RISC	RISC	RISC	CISC	RISC	RISC	RISC
1MB, 5MB	6MB, 66MB	2MB, 64MB	1MB, 2MB	6MB, 22MB	2MB, 66MB	6MB, 38MB
■ ■	■ ■	■ ■	■ □	■ ■	■ ■	■ ■
■ □	■ ■	■ □	■ □	■ □	■ □	■ □
□ □	■ □	Optional □	□	□ □	Optional □	■ □
■	■	■	□	■	■	■
■	■	■	□	■	■	■
150 (multipurpose)	250 (letter), 100 (multipurpose)	150 (multipurpose)	100 (multipurpose)	250 (multipurpose)	250 (letter), 100 (multipurpose)	250 (letter), 100 (multipurpose)
□ □	□ □	□ □	□ □	□ □	Optional □	Optional □
41	24	42	36	36	36	36
■	■	■	□	■	■	■
PCL 5	PCL 5e	PCL 5e	PCL 5	PCL 5e	PCL 5e	PCL 5e
300 x 300	600 x 600	600 x 600	300 x 300	600 x 600	600 x 600	600 x 600
N/A	Adobe Level 2	Level 2 clone (optional)	N/A	Adobe Level 2 (optional)	Adobe Level 2	Adobe Level 2
N/A	600 x 600	600 x 600	N/A	600 x 600	600 x 600	600 x 600
N/A	73	35	N/A	45	35	35
Epson FX-850, IBM Proprinter, XL 24E	DEC PPL3, REGis (optional), Tektronix 4010 and 4014 (optional)	Epson ESC/P 2, Epson FX series, Epson GL/2	HPGL	HPGL	HPGL/2	HPGL/2
□	■	■	□	□	□	□
N/A	N/A	N/A	N/A	N/A	N/A	N/A
□	■	■	□	■	Optional	■
■	■	■	■	■	■	■
□ □	Optional □	Optional □	Optional □	Optional □	Optional □	■ ■
□ *	□	□	■	■	■	■
□ *	■	■	■	■	■	■
□ □	□ □	□ □	■ ■	■ ■	■ ■	■ ■
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■	■	■	■	■	□	■
8:00 A.M.-8:30 P.M. M-F	8:00 A.M.-8:30 P.M. M-F	9:00-9:00 M-F	9:00-8:00 M-F	9:00-8:00 M-F	9:00-8:00 M-F	9:00-8:00 M-F
□	□	■	■ (CompuServe)	■ (CompuServe)	■ (CompuServe)	■ (CompuServe)
1 year	1 year	2 years	1 year	1 year	1 year	1 year

PC MAGAZINE **PC MAGAZINE**
EDITORS' CHOICE EDITORS' CHOICE

November 1994.

The TI microLaser Pro 600 PS23 (\$1,599 list; \$1,299 street) boosts rated speed to 8 ppm, and actually prints text in PostScript a little bit faster than rated. PostScript graphics performance at 600 dpi was excellent at 1.1 graphics pages per minute on our Graphics Speed test and 1.3 gppm on our CorelDRAW test. Print quality was equivalent to the microLaser 600. An accelerator option (\$349 list) provides a significant boost for PostScript graphics printing—about 50 percent faster for both 300 and 600 dpi images.

At \$1,899 (\$1,600 street) the top-of-the-line TI microLaser Power Pro adds a

Texas Instruments'
Ethernet adapter can
turn the microLaser
Power Pro or
microLaser Pro 600
into its own print server
in less than 10 minutes.

12-ppm laser print engine, making it more competitive with the latest HPs.

Texas Instruments' Ethernet adapter can turn the microLaser Power Pro or microLaser Pro 600 into its own print server. It took less than 10 minutes to install Ethernet hardware and software and print over the network. A DOS Printset utility monitors network printing but little remote management capability is offered.

The microLaser Power Pro's text speed times were even faster than its 12-ppm rating. The unit's PostScript graphics speeds and its times on the PostScript portion of our Windows applications tests were faster than average for its class. In addition, the built-in complement of 65 PostScript fonts is one of the largest on the market. The high-speed, PostScript microLaser Power Pro will appeal to individuals or small workgroups.

► **TI microWriter PS23.** List price: \$799; 1MB RAM upgrade, \$99; 2MB RAM up-



386-based PCs



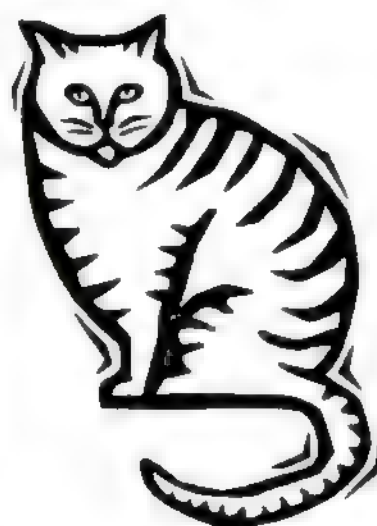
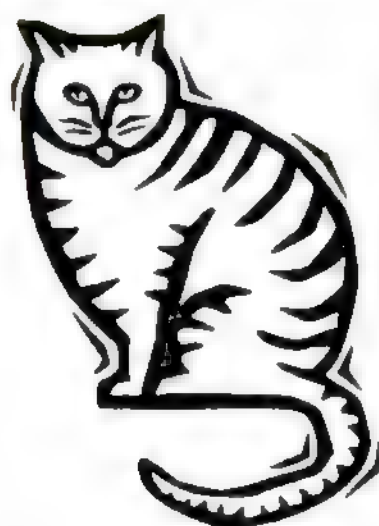
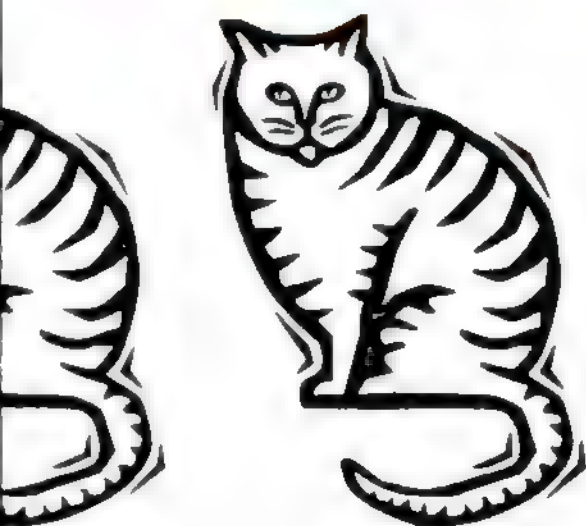
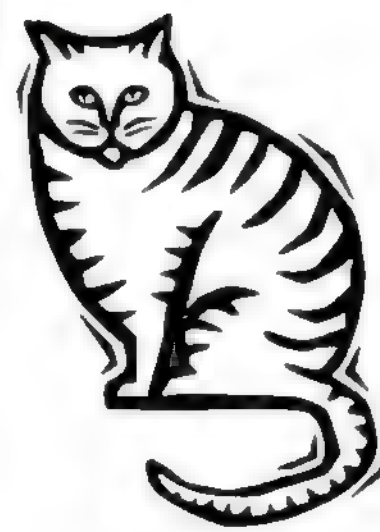
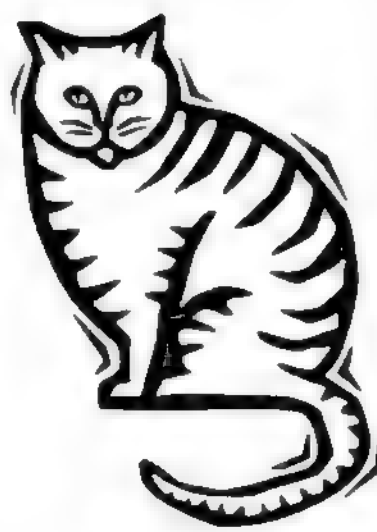
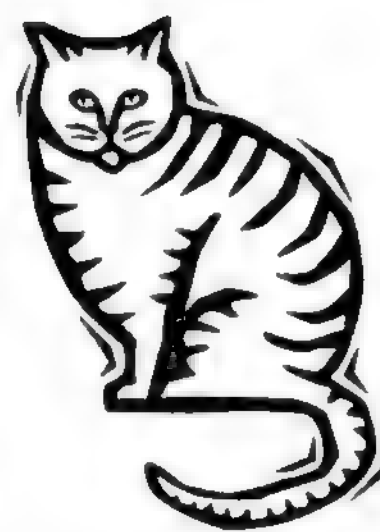
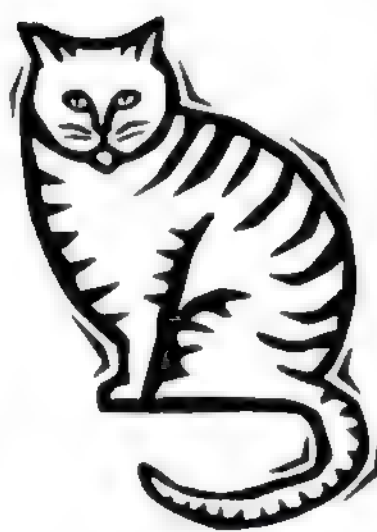
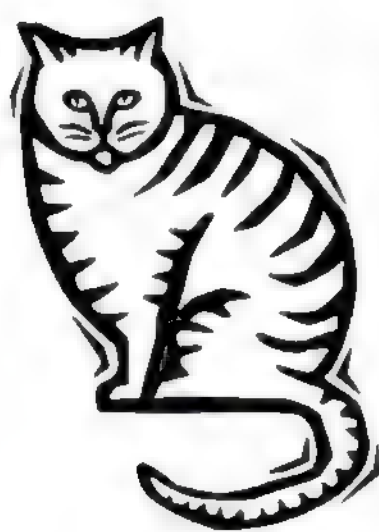
486-based PCs

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COVER STORY
Personal/Workgroup Lasers

► **S U M M A R Y O F F E A T U R E S**

In alphabetical order by company ■ = YES □ = NO		HP Color LaserJet	Lexmark IBM LaserPrinter 4037 SE	Lexmark Winwriter 600	Lexmark IBM LaserPrinter 4039 12R Plus	Lexmark IBM LaserPrinter 4039 12L Plus	Mannesmann Tally T9008	Okidata OL400e	Okidata OL410e
List price (base configuration)		\$7,295	\$799	\$1,199	\$1,749	\$2,299	\$1,499	\$699	\$899
Dimensions (HWD, in inches)		14.8 x 24.4 x 19.3	9.7 x 15 x 17.6	12.4 x 19.9 x 20.9	11.8 x 14.9 x 21	16 x 14.9 x 21	11.2 x 15.5 x 14.5	6.3 x 12.6 x 14.2	6.3 x 12.6 x 14.2
Weight (pounds)		103	30	34.5	40	46	37.8	17	17
Engine type/Rated speed (pages per minute)		Laser/10	LED/5	Laser/8	Laser/12	Laser/12	Laser/8	LED/4	LED/4
Engine model		Proprietary (Konica)	Lexmark 4037	Lexmark 4029	Lexmark 4039	Lexmark 4039	TEC LB 3500	OKI OL400e	OKI OL400e
Processor		20-MHz AMD 29030	16-MHz Motorola 68000	16.7-MHz Motorola 68000	16-MHz AMD 29200	16-MHz AMD 29200	20-MHz Intel i80960KA 32 Bit	16-MHz MIPS 3000	16-MHz MIPS 3000
Instruction set		RISC	CISC	CISC	RISC	RISC	RISC	RISC	RISC
Standard/maximum RAM		8MB, 72MB	512K, 4.5MB	2MB, 8MB	2MB, 16MB	4MB, 16MB	2MB, 32MB	512K, 4.5MB	2MB, 5MB
Interfaces									
Parallel/serial port		■ Optional	■ Optional	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Bidirectional/ECP parallel support		■ □	■ □	■ □	■ □	■ □	■ □	□ □	□ □
LocalTalk/SCSI port		Optional □	□ □	□ □	Optional □	Optional □	Optional □	□ □	□ □
Automatic interface switching		■	□	■	■	■	■	■	■
Simultaneously active ports		■	■	□	■	■	■	■	■
Paper Handling									
Capacity of each standard cassette (sheets)		250 (letter)	150 (multipurpose), 200 (letter), 1 (envelope)		200 (letter)	500 (letter)	250 (letter, A4, or legal), 100 (multipurpose)	100 (universal letter)	100 (universal letter)
Duplexing/Prints on B-size paper		□ ■	□ □	□ □	Optional □	Optional □	□ □	□ □	□ □
Rated maximum paper weight (pounds)		24	37	24	24	24	36	24	24
Fonts and Features									
Automatic emulation switching		Optional	■	■	■	■	■	□	□
PCL support		Enhanced PCL 5	PCL 4	PCL 4	PCL 5e	PCL 5e	PCL 5e	PCL 4/5	PCL 5
Maximum resolution in PCL (dpi)		300 x 300	300 x 300	300 x 300	600 x 600	600 x 600	600 x 600	300 x 300	300 x 300
PostScript support		Adobe Level 2 (optional)	N/A	N/A	Level 2 clone	Level 2 clone	Level 2 clone (optional)	N/A	N/A
Maximum resolution in PostScript (dpi)		300 x 300	N/A	N/A	600 x 600	600 x 600	600 x 600	N/A	N/A
Number of Type 1 fonts		35	N/A	N/A	39	39	35	N/A	N/A
Other emulations		None	IBM LaserPrinter 4019 and 4029, IBM Proprinter	None	None	None	None	None	None
Graphics									
GDI support		□	□	■	■	■	□	□	□
Maximum resolution (dpi)		N/A	N/A	600 x 600	600 x 600	600 x 600	N/A	N/A	N/A
TrueType rasterizer in firmware		■	■	■	■	■	■	□	□
Resolution enhancement		■	■	■	■	■	■	□	■
Network Support									
Internal Ethernet/Token-Ring		Optional □	Optional □	N/A	Optional □	Optional □	Optional □	Optional □	Optional □
Remote status messages		■	□	□*	■	■	■	□	□
Remote paper-tray selection		■	□	□*	■	■	■	□	□
Remote configuration/troubleshooting		■ ■	□ □	□* □*	■ ■	■ ■	■ ■	□ □	□ □
Remote modification of control panel by end user/administrator		■ ■	□ □	□* □*	■ ■	■ ■	□ ■	□ □	□ □
Customer Support									
Toll-free technical support		■	□	□	□	□	■	■	■
Telephone support hours (eastern time)		9:00-8:00 M-F	10:00-7:00 M-F	10:00-7:00 M-F	10:00-7:00 M-F	10:00-7:00 M-F	10:00-8:00 M-F	8:00-6:00 M-F	8:00-6:00 M-F
Service									
BBS or on-line service		■ (CompuServe)	■	■	■	■	■	■	■
Warranty (parts and labor)		1 year on-site	1 year	1 year	1 year	1 year	1 year	1 year, 5 years LED	1 year, 5 years LED

N/A—Not applicable. The product does not have this feature.
* This feature is available in a single-user configuration only.

CONTINUES



Panasonic SideWriter KX-P4400	QMS 1060 Print System	QMS magicolor	Sharp JX-9400H	Sharp JX-9460PS	Sharp JX-9660PS
\$699	\$2,699	\$9,999	\$599	\$849	\$1,499
11.7 x 5 x 15	14.3 x 16.2 x 19	14.6 x 20.5 x 22.2	10.5 x 13 x 14	10.5 x 13.0 x 14.4	12.8 x 13 x 14.4
14.5	37.5	86	27	26.7	32
LED/4	Laser/10	Laser/8	Laser/8	Laser/6	Laser/8
Matsushita 4400	Information not provided	Hitachi proprietary	Sharp JX-9400	Sharp 9460	Sharp JX-9660
16-MHz National Semiconductor NS32CG16	20-MHz IDT 9081	33-MHz Intel 80960CF	12-MHz Motorola 68000	16-MHz AMD AM29005	16-MHz AMD AM29005
CISC	RISC	RISC	CISC	RISC	RISC
1MB, 5MB	8MB, 64MB	12MB, 64MB	1.5MB, 4.5MB	2MB, 9MB	2MB, 9MB
■ Optional	■ ■	■ ■	■ Optional	■ Optional	■ ■
□ □	■ ■	■ □	□ □	□ □	□ □
Optional □	■ Optional	■ ■	□ □	Optional □	■ □
□	■	■	□	■	■
□	■	■	□	■	■
100 (multipurpose)	500 (letter), 150 (multipurpose)	250 (multipurpose)	250 (letter)	250 (multipurpose)	250 (letter), 250 (letter)
□ □	□ □	□ □	□ □	□ □	□ □
32	42	24	34	34	34
□	■	■	□	Optional	Optional
PCL 4	PCL 5	PCL 5C	PCL 4	PCL 5	PCL 5
300 x 300	300 x 300	300 x 300	300 x 300	300 x 300	300 x 300
Adobe Level 2 (optional)	Level 2 clone	Level 2 clone	N/A	Level 1 clone	Level 1 clone
300 x 300	600 x 600	600 x 600	N/A	600 x 600	600 x 600
N/A	39	65	N/A	13	13
None	HPGL, LNOC Plus, LN03 Plus, (optional) QUIC 2 (optional)	DECNet (optional), LN03 Plus	Diablo 630, Epson FX-80, IBM Graphics Printer, IBM Proprinter	Epson FX-80, IBM Graphics Printer, IBM Proprinter	Epson FX-80, IBM Graphics Printer, IBM Proprinter
□	□	□	□	□	□
N/A	N/A	N/A	N/A	N/A	N/A
□	■	■	□	□	□
□	□	□	□	■	■
□ □	Optional	Optional	□ □	□ □	□ □
□ *	■	■	□	□	□
□	■	■	□ *	□ *	□ *
□ □	■ ■	■ ■	□ □	□ □	□ □
□ □	■ ■	■ ■	□ □	□ □	□ □
■	□	■	■	■	■
8:00-8:00 M-F	7:00 A.M.-8:00 P.M. M-F	7:00 A.M.-8:00 P.M. M-F	9:00-5:00 M-F	9:00-5:00 M-F	9:00-5:00 M-F
■	■	□	□	□	□
1 year; 5 years LED	1 year	90 days (extensions are available)	1 year	1 year	1 year

grade, \$198; universal cassette (holds 250 sheets of letter-, legal-, or A4-size paper, or 30 envelopes), \$139; 250-sheet letter-size feeder, \$199; toner, \$49; imaging kit, \$169; Epson FX/Diablo/IBM Proprinter emulation kit, \$49. **TI microLaser 600.** List price: \$999; same options and prices as the microWriter PS23, except there are no emulation kits included. **TI microLaser Pro 600 PS23.** List price: \$1,599; 1MB RAM upgrade, \$119; 2MB RAM upgrade, \$199; 4MB RAM upgrade, \$299; 8MB RAM upgrade, \$599; 250-sheet letter-size paper cassette, \$99; legal-size paper cassette, \$99; 30-envelope cassette, \$109; 250-sheet A4-size cassette, \$49; serial port option, \$49; SCSI disk interface, \$149; PowerStep processor upgrade, \$349; Ethernet interface, \$399; OPC cartridge, \$179; imaging cartridge, \$199; PS23 to PS65 font upgrade, \$199. **TI microLaser Power Pro.** List price: \$1,899; same options and prices as the microLaser Pro 600 PS23, except there is no PS23 to PS65 font upgrade included. Texas Instruments Inc., P.O. Box 149149, Austin, TX 76714; 800-527-3500, 512-794-5970; fax, 512-250-7329.

Circle 481 on reader service card

Xerox Corp.

- **Xerox 4505ps**
- **Xerox 4510ps**
- **Xerox 4900 Color Laser Printer**

BY BRUCE BROWN

Xerox offers two price-competitive 600-dot-per-inch workgroup lasers and an innovative Color Laser Printer. At \$1,629 list (\$1,300 street) the Xerox 4505ps turns out 5 pages per minute and has a 10,000-page duty cycle. If you don't need PostScript, the 4505ps with only PCL 5e lists for \$1,229 (\$983 street). At \$2,379 (\$1,900 street) the sturdy Xerox 4510ps doubles the page rate and the duty cycle. Without PostScript, the 4510 lists for \$1,839 (\$1,470 street). The Xerox 4900 Color Laser Printer (\$8,495 list, \$7,995 street), rated at 12 monochrome ppm and 3 color ppm, offers Xerox-patented Quad Dot Printing, which smooths color dithering patterns. It also offers up to 1,200-by-300-dpi resolution (with a 16MB RAM upgrade) in PostScript (300 dpi in PCL 5).

COVER STORY
Personal/Workgroup Lasers

► **S U M M A R Y O F F E A T U R E S**

ENDS

In alphabetical order by company

■ = YES □ = NO

	TI microWriter PS23	TI microLaser 600	TI microLaser Pro 600 PS23	TI microLaser Power Pro	Unisys AP9312 Plus	Xerox 4505ps	Xerox 4510ps	Xerox 4900 Color Laser Printer
List price (base configuration)	\$799	\$999	\$1,599	\$1,899	\$1,895	\$1,629	\$2,379	\$8,495
Dimensions (HWD, in inches)	10.4 x 13.8 x 14.8	10.4 x 13.8 x 14.8	12.8 x 13 x 14.4	12.8 x 13 x 14.4	11.8 x 14.9 x 21	10 x 13.9 x 15.5	10 x 13.9 x 15.5	15 x 24 x 21.7
Weight (pounds)	33	33	32	32	40	31	31	108
Engine type/Rated speed (pages per minute)	LED/5	Laser/5	Laser/8	Laser/12	Laser/12	Laser/5	Laser/10	Laser/12
Engine model	Samsung SL 1050	Samsung SL 1050	Sharp JX-9600	Sharp JX-9612	Lexmark 4039	Fuji Xerox XP-5	Fuji Xerox XP-10	Hitachi Color Engine
Processor	16-MHz Motorola 68000	16-MHz IDT 3041	20-MHz IDT 3041	25-MHz IDT 3041	16-MHz AMD 29200	16-MHz AMD 29200	20-MHz AMD 29200	25-MHz AMD 29030
Instruction set	CISC	RISC	RISC	RISC	RISC	RISC	RISC	RISC
Standard/maximum RAM	2MB, 4.5MB	2MB, 10MB	6MB, 22MB	6MB, 22MB	2MB, 16MB	6MB, 16MB	6MB, 16MB	12MB, 48MB
Interfaces								
Parallel/serial port	■ Optional	■ Optional	■ Optional	■ Optional	■ ■	■ ■	■ ■	■ ■
Bidirectional/ECP parallel support	■ □	■ ■	■ ■	■ ■	■ □	■ □	■ □	■ □
LocalTalk/SCSI port	□ □	■ Optional	■ Optional	■ Optional	□ □	Optional □	Optional □	■ □
Automatic interface switching	□	■	■	■	■	■	■	■
Simultaneously active ports	□	■	■	■	■	■	■	■
Paper Handling								
Capacity of each standard cassette (sheets)	250 (letter)	250 (letter)	250 (letter), 250 (letter)	250 (letter), 250 (letter)	200 (letter)	250 (letter), 50 (multipurpose)	250 (letter), 50 (multipurpose)	250 (multipurpose)
Duplexing/Prints on B-size paper	□ □	□ □	□ □	□ □	Optional □	□ □	□ □	□ □
Rated maximum paper weight (pounds)	24	36	34	32	24	36	36	90
Fonts and Features								
Automatic emulation switching	■	■	■	■	■	■	■	■
PCL support	PCL 4	PCL 5	PCL 5	PCL 5	PCL 5e	PCL 5e	PCL 5e	PCL 5
Maximum resolution in PCL (dpi)	300 x 300	300 x 300	300 x 300	300 x 300	600 x 600	600 x 600	600 x 600	300 x 300
PostScript support	Adobe Level 1	Adobe Level 2	Adobe Level 2	Adobe Level 2	Level 2 clone	Adobe Level 2	Adobe Level 2	Adobe Level 2
Maximum resolution in PostScript (dpi)	300 x 300	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600	1,200 x 300**
Number of Type 1 fonts	24	23	23	65	39	35	35	35
Other emulations	Diablo 630, Epson FX series, IBM Proprinter	None	None	None	None	None	None	None
GDI support	□	□	□	□	□	□	□	□
Maximum resolution (dpi)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TrueType rasterizer in firmware	□	■	□	■	■	■	■	■
Resolution enhancement	□	□	□	□	■	■	■	■
Network Support								
Internal Ethernet/Token-Ring	□ □	□ □	Optional □	Optional □	Optional Optional	Optional Optional	Optional Optional	Optional Optional
Remote status messages	□	□*	□	□	■	■	■	■
Remote paper-tray selection	□	□*	□	□	■	■	■	■
Remote configuration/troubleshooting	□ □	□ □	□ □	□ □	■ □	■ ■	■ ■	■ ■
Remote modification of control panel by end user/administrator	□ □	□ □*	□ □	□ □	■ ■	■ ■	■ ■	■ ■
Customer Support								
Toll-free technical support	■	■	■	■	■	■	■	■
Telephone support hours (eastern time)	8:00-8:00 M-F	8:00-8:00 M-F	8:00-8:00 M-F	8:00-8:00 M-F	24 hours, 7 days	8:00-8:00 M-F	8:00-8:00 M-F	8:00-8:00 M-F
BBS or on-line service	■	■	■	■	■ (SureNet)	□	□	□
Warranty (parts and labor)	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year; on-site limited

N/A—Not applicable. The product does not have this feature

* This feature is available in a single-user configuration only

** The maximum resolution requires additional RAM

All three reviewed models offer authentic Adobe PostScript Level 2. An optional Ethernet interface (\$499 for the monochrome models, \$649 for the 4900) gives users of the 4505ps and 4510ps access to Xerox's excellent Windows-based Document Services for Printing (DSP) software, which duplicates the printer's control panel on-screen. A job accounting module not only tracks pages printed by job, printer, and user, but also bills accordingly through charge-back reports.

On our Text Speed test, the 4505ps's Fuji-Xerox XP-5 engine scored 4.9 ppm in both PCL 5e and PostScript. Graphics Speed test scores were respectable at 1.5 graphics pages per minute in PCL and 0.9



Xerox 4900 Color Laser Printer

gppm in PostScript. Graphics print quality was superb.

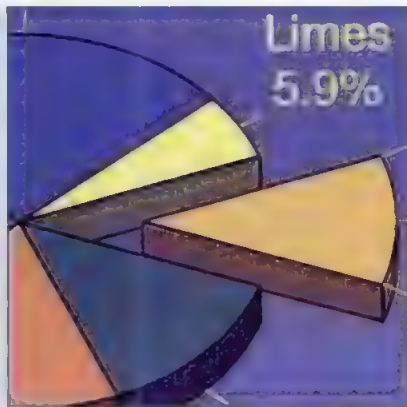
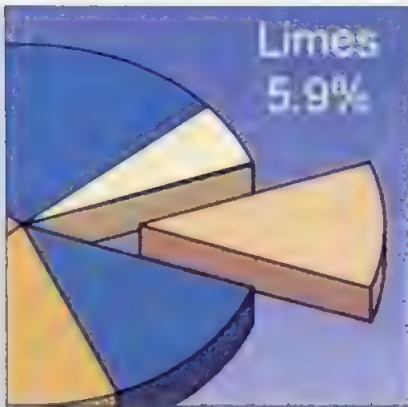
With the help of a faster XP-10 engine, the 4510ps almost doubles 300-dpi text speeds to 9.7 ppm in PCL 5, 9.5 ppm in PostScript. Graphics speeds at 600 dpi

moved up to 1.4 gppm in PCL, 1.1 gppm in PostScript.

Based on a Hitachi color engine and 25-MHz AMD 29030 RISC processor, the 4900 brings plain-paper color/monochrome printing to the small office. On our 300-dpi color tests the 4900 produced bright colors but dithering was noticeable and the registration was a little bit off in printing process black. On our 1,200-by-300-dpi color print tests, the 4900 fared very well, with bright, saturated colors and no noticeable dithering, but the registration was still a little off in composite black text. The unit's cost per color page is on the high side at 25.4 cents for 5 percent coverage of black, cyan, magenta, and yellow (total

■ Color Output Samples: *Laser Printers*

Color laser output offers crisp edges and vibrant colors for graphics. Note that the HP Color LaserJet output, limited to 300- by 300-dpi resolution, shows far more obvious dithering patterns than the QMS or Xerox printer outputs.



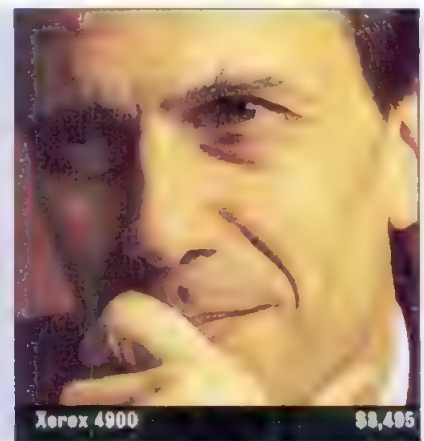
HP Color LaserJet

\$7205



QMS magicolor

\$9,999



Xerox 4900

\$8,495


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20 percent) when compared with the magicolor's 20 cents and HP Color LaserJet's 10.7 cents.

The 4900's 300-dpi monochrome mode, which was rated at 12 ppm, printed PCL text at 8.2 ppm, PostScript graphics at 0.6 gppm. At rated speeds of 6 ppm in two-color mode and 3 ppm in full color, the 4900's text speed dropped proportionately, but monochrome graphics

*The innovative
Xerox 4900 Color
Laser Printer brings
plain-paper color/
monochrome printing to
the small office.*

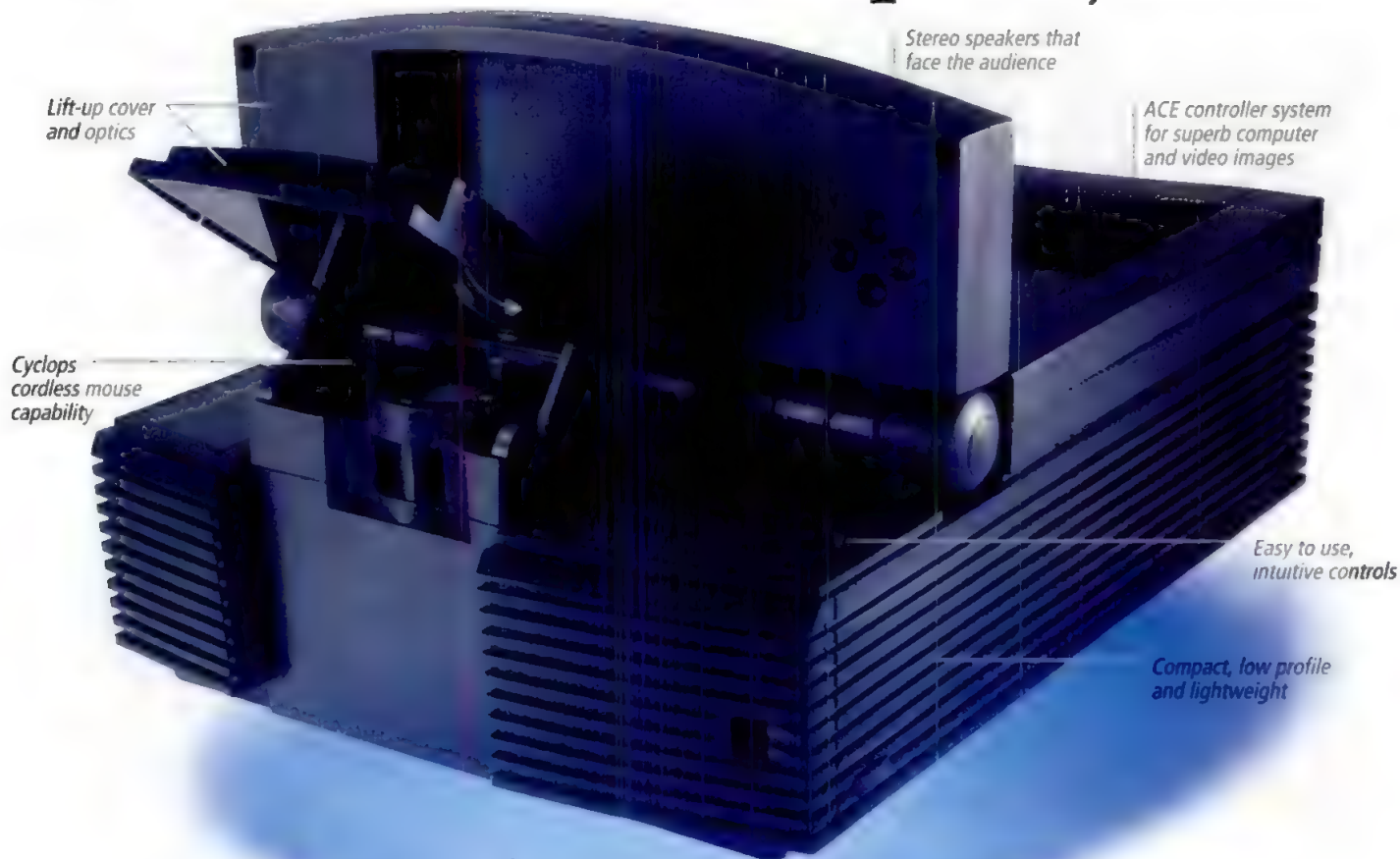
speed hovered at around 0.56 gppm.

The 4900 we tested came complete with 24MB of RAM and the optional Media Server kit, which lets you print pure PCL 5 and PostScript files from a floppy disk drive built into the front of the case. □

► **Xerox 4505ps.** List price: \$1,629; 4MB RAM, \$299; 16MB RAM, \$1,099; 250-page sheet feeder, \$179; 500-page sheet feeder, \$349; 30-envelope feeder, \$119; LocalTalk interface kit, \$185; Ethernet interface kit, \$499; Token-Ring interface kit, \$699; toner cartridge, \$103. **Xerox 4510ps.** List price: \$2,379; same options and prices as the 4505ps. **Xerox 4900 Color Laser Printer.** List price: \$8,495; 8MB RAM, \$499; 16MB RAM, \$949; additional 250-sheet paper cassette, \$125; 250-sheet lower paper feeder, \$625; 30-envelope cassette, \$135; Ethernet interface kit, \$649; Token-Ring interface kit, \$849; printer cabinet, \$250; 4,000-page black toner cartridge, \$45; 4,000-page color (cyan/magenta/yellow) toner cartridges, \$200 each; 30,000-page black developer, \$175; 30,000-page color (cyan/magenta/yellow) developers, \$250 each; OPC cartridge, \$340. Xerox Corp., Office Document Systems Division, 80 Linden Oaks, Rochester, NY 14625; 800-275-9376.

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CIRCLE 122 ON READER SERVICE CARD

Fast and Flexible

Departmental lasers have evolved from fast, dumb workhorses to intelligent network devices that can serve dozens of users printing over multiple network operating systems.

*By James Karney and
Leon Erlanger*

Things have come a long way since the only requirements for a network laser printer were a fast engine and a hefty duty cycle. The 13 products we evaluate in this section provide a look at the state of the art, offering direct connection to the network, bidirectional communications, remote management, and the flexibility to ful-

fill the needs of varied users and network environments.

A network printer can be anything from a 6-page-per-minute printer shared among five users to a 32-ppm (or higher) workhorse fulfilling the needs of many dozens of users running on different operating systems and with different needs. Recognizing that a printer doesn't have to be fast to end up on a network today, we've revised our coverage of the laser market. Last year we defined any laser print-



Departmental Lasers

er that printed at under 12 ppm as a personal laser and any laser printer that printed 12 ppm and above as a network laser. This year we've divided laser printer coverage into a personal and work-group laser section, which covers lasers with engine speeds up to and including 12 ppm, and this departmental laser section, which covers lasers that print over 12 ppm. Aside from print speed, departmental lasers generally offer hefty duty cycles (10,000 pages per month and up), flexibility in the form of emulation and network-protocol switching, and sophisticated remote-management tools, which let users and administrators monitor print jobs and printer status from a PC.

According to BIS Strategic Decisions, the number of 13- to 40-ppm laser printers sold in the U.S. in 1994 will be 226,000—compared with 190,200 in 1993. That's a 19 percent increase, more than any other category of laser printer.

REVIEW CRITERIA

In addition to having a print engine rated above 12 ppm, a laser printer had to have entered distribution channels since last

year's printer review and before September 1, 1994, to make it into this roundup. The only exceptions were last year's Editors' Choices—the HP LaserJet 4Si MX and the QMS 3225 Print System—which we retested to see how they would fare

LaserJet 4V and HP LaserJet 4MV) that were shipping after our deadline and are profiled in a sidebar. Of those 13 printers, 2 were designed more for specialized tasks than for standard departmental networking environments. The AMT

TracJet III is a tractor-feed, continuous-form laser printer designed for heavy-duty industrial work such as printing labels, bar codes, and stocking tags on different kinds of paper and materials. The Xante Accel-a-Writer 8200 is meant for printing large-format (11- by 25-inch), high-resolution PostScript graphics.

The following printers did not arrive in time for testing: Bull HN Information Systems' PageMaster 1725, a 17-ppm network laser with built-in duplexing for \$3,195; Ricoh Corp.'s LP-M32IP, a 32-ppm PCL printer with PostScript and Ethernet options (no price available); and Lexmark International's new family of 1,200-dot-per-inch network lasers (no prices available) with PostScript Level 2 and PCL 5—the 12-ppm Optra R and Optra L and the 16-ppm Optra Lx and Optra Lsi.

We submitted all the printers to our Text and Graphics Speed tests as well as

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against this year's entries. We did not bring back the Compaq PageMarq 20, which also earned an Editors' Choice last year, because Compaq has withdrawn from the printer market (though the PageMarq is still sold in some channels).

In all, we received 11 printers from eight vendors, plus two printers (the HP

HIGHLIGHTS

Departmental Lasers

DEPARTMENTAL LASER printers are the fastest-growing segment of the laser printer market. Though many provide network connectivity, a departmental laser usually offers a fast-rated engine speed (above 12 ppm), a high duty cycle (above 10,000 pages per month), automatic emulation and protocol switching, and remote management tools.

THE SPEED DEMON from this year's group was the QMS 3225 Print System, a 32-ppm cheetah that outclassed all others on our DOS speed benchmark tests. The HP LaserJet 4Si MX, Lexmark IBM LaserPrinter 4039 16L Plus, and Xerox 4520mp were also respectable performers.

THE MORE COMPLEX your organization, the more flexible a network printer has to be. Mixed operating environments (PC? Mac? Unix?) and differing individual needs (300-dpi text? higher-resolution PostScript graphics?) require a printer that can switch automatically between emulations and network protocols as different jobs come in.

REMOTE MANAGEMENT UTILITIES allow end users to monitor print jobs from their PCs and network administrators to track the various networked printers spread throughout an organization. Of the 13 printers we looked at, 12 offer software utilities that let managers configure, monitor, and maintain

printers remotely. We were especially impressed with the slick implementations from Hewlett-Packard, Lexmark, and Xerox.

PAPER HANDLING is another important consideration when you're looking at departmental lasers. You'll want large capacity (three printers here offer 1,000-sheet capacity standard) and multiple trays for other media such as B-size paper and envelopes. Duplexing—printing on both sides of a sheet—can save a lot of paper in large organizations. Five of the lasers reviewed here offer duplexing units as an option. The Xerox 4220 even has a duplexing feature built in.

our Microsoft Windows applications tests, which gauge a printer's real-world performance running popular Windows applications. In addition, we ran our new Network Speed test on those printers that came with or offered optional internal network interface cards (NICs). This test sends several large PostScript and PCL files to the printer over the network (alternating PostScript and PCL) to test the printers' emulation-switching capabilities as well as their ability to accept and print files quickly.

In a class by itself, the QMS 3225 Print System was the clear winner when it came to raw print speed, printing text at a blazing 29.4 ppm and PCL graphics at 4.8 graphics pages per minute. For PostScript graphics, the QMS 1660 Print System was the leader at 1.8 gppm. The QMS 3225 also led the pack in Word for Windows performance, but under some emulations on our CorelDRAW and Lotus 1-2-3 for Windows tests it was beaten out by the HP LaserJets and the QMS 1660. The HP LaserJets and Xerox 4520mp also proved to be top Windows performers. The Xerox 4220 and the HP LaserJet 4Si MX were the champs on our Network Speed test, printing all our jobs in 2 minutes 11 seconds and 2 minutes 55 seconds, respectively. The loser was the Dataproducts LZR2080, which took almost 29 minutes to complete our Network Speed test.

STAYING FLEXIBLE

Every network setup is different. If all your company or department needs to do is pump out page after page of text, then a fast printer with a hefty duty cycle is your top priority; the speed-demon QMS 3225 with its 200,000-page monthly duty cycle is the obvious king of the hill. But



A-size printing:

- **HP LaserJet 4Si MX**

B-size printing:

- **Xerox 4520mp**

Departmental laser printers—those with engine speeds rated above 12 ppm—represent the fastest-growing segment of the laser printer market. There were no real disappointments among the 13 units we looked at, and there were some standouts.

For the second year in a row, our Editors' Choice designation for A-size printing goes to the HP LaserJet 4Si MX. A reasonable \$4,550 (street) delivers a 17-ppm workhorse with a respectable 75,000-page-per-month duty cycle. You also get an internal network interface card and PostScript Level 2 (with automatic emulation switching) and dual 500-sheet paper trays. The quality of the 600-dpi output was unsurpassed, and the 4Si MX was one of the fastest departmental lasers in this roundup. But it's Hewlett-Packard's extras that make this printer worth the investment. HP's installation software and JetAdmin utilities make set-up and administration easy, and the JetPrint utility offers some of the best remote-management capability we've seen. If you don't need PostScript or a direct connection to the network, the HP LaserJet 4Si gives you everything else (with PostScript and a network interface card as options) for \$2,899 (street).

The Xerox printers in this section also boast outstanding setup and remote-management software. Shops that need B-size output should look at the Xerox 4520mp desktop laser printer. Positioned as a departmental laser for up to 25 users, the 20-ppm printer gives you above-average

throughput, PostScript Level 2 compatibility, and a duty cycle of 50,000 pages per month for \$4,100 (street). The 4520mp comes with Xerox's Document Services for Printing, an excellent collection of remote management tools that allow an administrator to monitor printer status, manage user accounts, track usage, and even charge individuals based on pages printed.

Two specialty printers deserve an honorable mention. For high-volume departmental printing, the QMS 3225 Print System offers blazing 32-ppm throughput and a duty cycle of 200,000 pages per month. It can serve 100 or more users and offers B-size output at a resolution of 400 dpi. Not surprisingly, the unit was far and away the fastest on our DOS benchmark tests—and, at almost 20 grand, the most expensive. At the other end of the speed spectrum, the 16-ppm Xante Accel-a-Writer 8200 delivers exceptional output: 600 dpi in its base configuration (\$4,495 list), upgradable to 1,200 dpi. Halftones showed fine detail; text was crisp; and the unit can print edge-to-edge on paper up to 11.75 inches by 25 inches. For demanding engineering and desktop publishing departments, the Xante is an ideal choice.

many medium-size to large networks today contain different types of users with diverse requirements. The accounting department may simply need to print 300-dpi text off its PCs, while the graphics department, printing off a Mac, may need 600-dpi or better PostScript. You may even have Unix workstations on the same network. Network laser vendors have devised sophisticated ways to deal with these requirements over the years.

Nearly all of the printers in this section can switch automatically among PostScript (standard or optional on all of the printers), PCL, and other emulations and can receive print jobs simultaneously from all their ports, including LocalTalk (if the printer comes with a LocalTalk port). The exception is the Digital PrintServer 17/600, which has a direct network connection and no ports.

All of the printers except the TracJet

Benchmark Tests: Departmental Lasers

The top performers on our nonnetwork tests were the QMS 3225 Print System, the QMS 1660 Print System, and the Xerox 4520mp. The Xerox 4220 and the HP LaserJet 4Si MX were the leaders printing large files over the network.

What the Numbers Mean

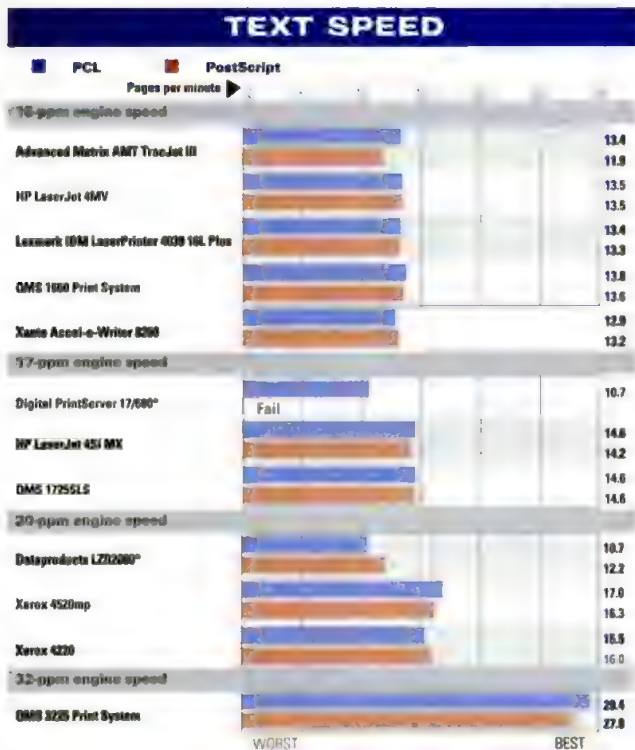
The fastest printer on the Text Speed test in both PCL and PostScript modes was (not surprisingly) the only 32-page-per-minute entry: the QMS 3225 Print System. This past Editors' Choice recipient (November 23, 1993) churned out 29.4 ppm in PCL mode and 27.8 ppm in PostScript; it also topped all others in PCL graphics output, at 4.8 graphics pages per minute. The quickest PostScript graphics unit was another QMS printer—the 1660 Print System, which produced 1.8 gppm at both 300- and 600-dpi resolutions.

Out of the remaining crowd of slower-rated units, the new 20-ppm Xerox 4520mp was an excellent performer. It came in second across the board, producing PCL text at 17.0 ppm, PostScript text at 16.3 ppm, PCL graphics at 3.4 gppm, and PostScript graphics at 1.7 gppm.

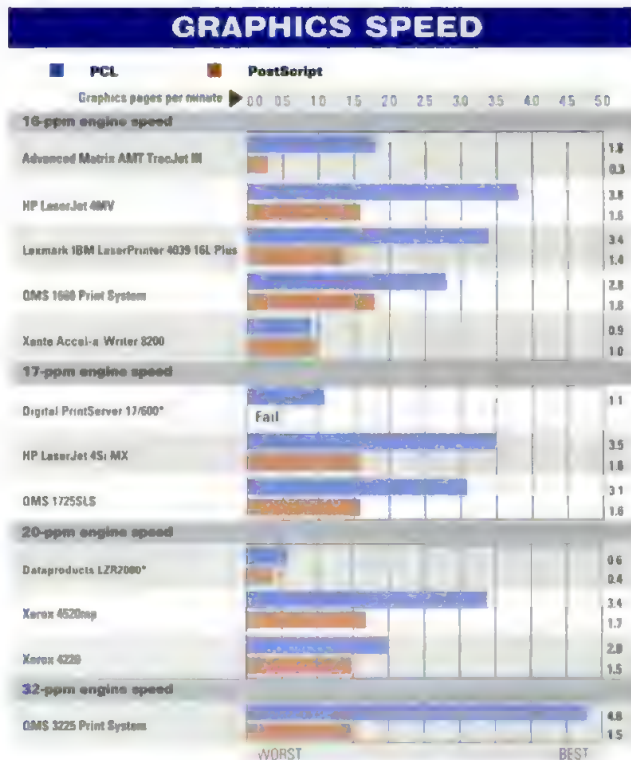
The 17-ppm Digital PrintServer 17/600 and 20-ppm Data-products LZR2080 did poorly on our throughput tests; because they lack a parallel port, we were forced to run tests over a network. The PrintServer was also the only PostScript-

equipped departmental laser to fail the PostScript portions of our Text Speed and Graphics Speed tests (DEC's version of PostScript is not true Adobe).

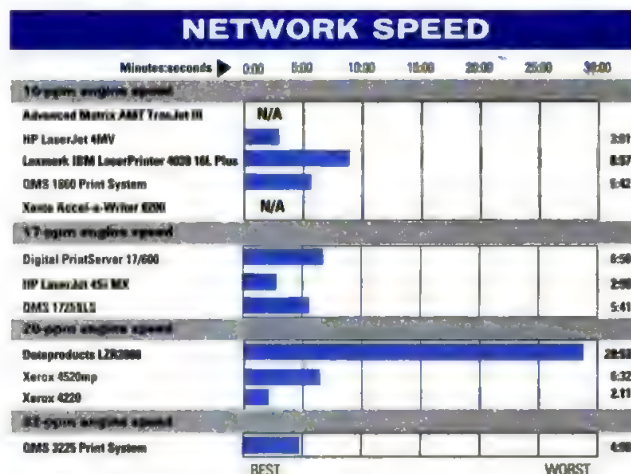
Our Network Speed test measures a printer's ability to accept and print jobs quickly. Its results are mostly attributes of the printer's network interface card (NIC) and, in small part, the processor and memory. We forced the printers to switch between PCL and PostScript emulations by alternating print jobs in each mode. Some print-



* The printer we received did not have a parallel port, so speed tests were conducted over a network.
Fail—The printer could not complete the PostScript versions of our tests.



* The printer we received did not have a parallel port, so speed tests were conducted over a network.
Fail—The printer could not complete the PostScript versions of our tests.



N/A—Not applicable. The printer does not have a network interface card.

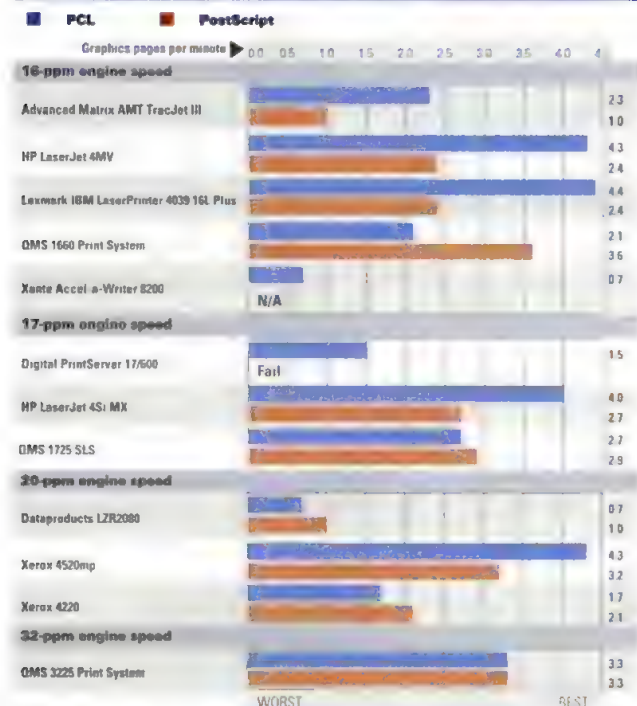
ers are capable of simultaneously accepting jobs while printing, which greatly improves their performance on this test. The fastest printer was the Xerox 4220, which required only 2

WORD FOR WINDOWS



N/A—Not applicable. The printer driver does not support 300-dpi resolution in PostScript emulation.
Fail—The printer could not complete the PostScript versions of our tests.

LOTUS 1-2-3 FOR WINDOWS



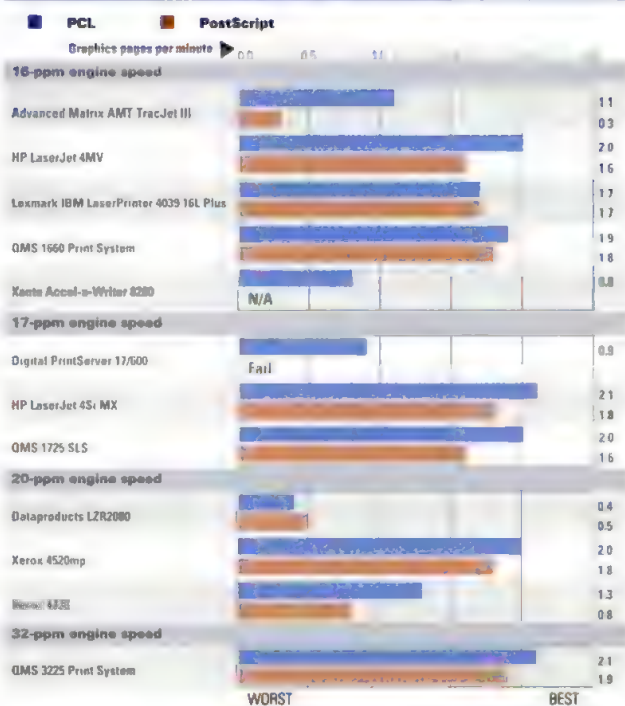
N/A—Not applicable. The printer driver does not support 300-dpi resolution in PostScript emulation.
Fail—The printer could not complete the PostScript versions of our tests.

minutes 11 seconds to build and despool our 6-file, 12-page test. The Dataproducts LZR2080 came in last with the remarkably slow score of 28 minutes 53 seconds. Unlike all of the other printers we tested, this unit required not one but two print queues—one for PCL jobs and one for PostScript. This, combined with printer's full emulation switching, caused delays when alternating between our PCL and PostScript jobs.

The results on our Microsoft Windows applications tests—Word for Windows, Lotus 1-2-3 for Windows, and CorelDRAW—have as much to do with a printer's Windows driver as with the printer itself. The 32-ppm QMS 3225 was by far the fastest at producing Word for Windows text output, but its dominance was not so clear in graphics output. On our Lotus 1-2-3 for Windows test, the Lexmark IBM LaserPrinter 4039 16L Plus proved the fastest (4.4 gppm) in PCL mode, but the QMS 1660 was the quickest in PostScript mode (3.6 gppm). The HP LaserJet 4Si MX tied the QMS 3225 in CorelDRAW output in PCL mode (2.1 gppm), but the QMS 3225 edged it out in PostScript mode (1.9 gppm).

We also tested each printer's power consumption in three modes: at rest, while printing, and in power-saving mode (if any). Three printers—the AMT TracJet III, Lexmark IBM LaserPrinter 4039 16L Plus, and QMS 1660—claimed Energy Star compliance, which means they must power down to below 45 watts at rest. We found the TracJet, however, to be above that threshold, consuming 48 watts in energy-saver mode. The Xerox 4220 draws more amperage than the allowable maximum of our test device, so no reading could be made. Of the units we could test, the TracJet consumed the most power while printing (464 watts), largely due to its internal tractor feeding mechanism.

CORELDRAW



N/A—Not applicable. The printer driver does not support 300-dpi resolution in PostScript emulation.
Fail—The printer could not complete the PostScript versions of our tests.



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**TEXAS
INSTRUMENTS**

How We Tested

The **Text Speed** test measures the printer's speed producing ten copies of a two-page business letter with 1-inch margins.

The **Graphics Speed** test measures the printer's speed in producing two copies of a complex single-page graphic containing a TIFF image, horizontal and vertical gray scales, and line art. A print file is sent to the parallel port directly from DOS.

The **Network Speed** test measures a printer's ability to accept and print jobs quickly. We loaded the print queue with three 725K PCL print jobs and three 3.7MB PostScript print jobs, alternating PostScript and PCL.

The **Word for Windows** test measures the printer's speed in producing a ten-page report that uses multiple fonts and type styles. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

The **Lotus 1-2-3 for Windows** test measures the printer's speed in producing a complex two-page spreadsheet that contains pie, bar, and line charts. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

The **CorelDRAW** test measures the printer's speed in producing a single-page CorelDRAW graphic that contains a TIFF image, horizontal and vertical gray scales, and line art. We tested each printer with the Microsoft

also come standard with or offer an optional network interface card. This lets you connect the printer directly as a live node anywhere on the network, obviating the need to dedicate a PC as a print server. All offer Ethernet; all but the Dataproducts, the PrintServer, and the Accel-a-Writer offer Token-Ring connections. The QMS and HP printers and the Xerox 4520mp can even take one of each interface card and switch between Ethernet and Token-Ring.

We went through Ethernet card installation with every printer except the TracJet, whose interface card was offered by a third-party vendor (Extended Systems), and the Accel-a-Writer, whose card did not run over NetWare (Xante expects to add that capability by early 1995). Ease of installation varied but was much improved from last year. Hewlett-Packard Co., Xerox Corp., and Lexmark International offer slick Windows-based utilities that shield you from NetWare's PCONSOLE and make network setup a 10- or 15-minute affair. The QMS printers were easy enough to assemble but left us to deal with PCONSOLE when it came to configuring the printer on the network. QMS plans to have its own installation utility by the time you read this. Installation of the PrintServer was complicated by the fact that Digital provides

a print server NetWare Loadable Module (NLM) that communicates with the printer via TCP/IP; if you don't know TCP/IP, you may run into problems.

All the NICs we looked at except the Xerox 4220's claim to switch automatically between jobs running over some combination of IPX, EtherTalk, TCP/IP, and Lan Manager's DLC/LLC protocols—so your Mac and Unix workstation users can share the printers with their PC brethren and send print jobs over the network at will. The HP LaserJets are the most flexible here, with the ability to switch among 12 different network operating systems. Dataproducts' Virtual Printer Technology takes a unique approach to flexibility on the network. Virtual Printer Technology allows the network administrator to configure up to 64 different workgroups or users with different default emulations, resolutions, paper sizes, and so on; users feel like they're using a printer specifically designed for their own needs. The graphic artist seems to use a B-size 800-dpi PostScript printer, while the accountant seems to print to a standard 300-dpi printer. This is a clever idea in concept, but the need to configure separate printer queues for PCL and PostScript jobs seems to have considerably slowed down the Dataproducts' performance on our Network Speed test.

POWER CONSUMPTION

	Power consumption at rest (watts)	Power consumption when printing (watts)	Power consumption in power-saver mode (watts)
Advanced Matrix AMT TracJet III	92	464	48
Dataproducts LZR2080	119	447	N/A ¹
Digital PrintServer 17/600	152	370	N/A ¹
HP LaserJet 4MV	99	381	32
HP LaserJet 4SI MX	99	364	38
Lexmark IBM LaserPrinter 4039 16L Plus	73	221	25
QMS 1660 Print System	110	395	31
QMS 1725SLS Print System	135	402	N/A ¹
QMS 3225 Print System	N/A ²	N/A ²	N/A ²
Xante Accel-a-Writer 8200	122	346	N/A
Xerox 4520mp	111	430	43
Xerox 4220	N/A ³	N/A ³	N/A ³

N/A¹—Not applicable: The printer does not have a power-saver mode.

N/A²—Not applicable: The printer draws more power than the 10-amp maximum of our Dranetz test device.

N/A³—Not applicable: The printer's power cable was not compatible with our Dranetz test device.

Windows driver recommended by the printer's manufacturer.

The **Power Consumption** test measures the printer's energy usage under three conditions: when printing, when idle, and when in power-saving mode (where available).

REMOTE POSSIBILITIES

Besides flexibility, 7 out of the 13 departmental lasers provide bidirectional communications and remote-management utilities that let administrators and end users configure and monitor print jobs without having to leave the PC. The HP LaserJets, the Lexmark IBM LaserPrinter 4039 16L Plus, the QMS 1660, and the Xeroxes come with bidirectional parallel ports, which let printer drivers alert end users and administrators to paper jams, lack of toner, and other conditions that once required a walk down the hall. They also let end users choose cassettes and modify the control panel from their desktops.

HP, Xerox, QMS, Dataproducts, and Digital offer remote-management utilities with their NICs. Novell's PCONSOLE already provides some remote-management capabilities, but the vendors' utilities take several steps forward. (See the sidebar "Fewer Walks down the Hall" for a more detailed discussion of remote management.) Xerox's Document Services for Printing (DSP) offers the most powerful features here, including the ability to track usage and even poll available Xerox queues to determine the best match of resolution, speed, and paper handling to a particular job. An administrator can query the DSP and obtain reports by network or individual printer.

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Advanced Matrix AMT TracJet III

\$6,995

16-ppm continuous-form laser printer (Pentax PL-0301 engine) with 300- by 300-dpi output, PostScript Level 2 clone (optional), PCL 5

PCL Text Speed: 13.4 ppm
PCL Graphics Speed: 1.8 gppm
PS Text Speed: 11.9 ppm
PS Graphics Speed: 0.3 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 8.6 ppm
Lotus 1-2-3 for Windows: 2.3 gppm
CorelDRAW: 1.1 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 7.5 gppm
Lotus 1-2-3 for Windows: 1.0 gppm
CorelDRAW: 0.3 gppm



HP LaserJet 4MV

\$3,549

16-ppm B-size laser printer (Canon BX-2 engine) with 600- by 600-dpi output, Adobe PostScript Level 2, enhanced PCL 5

PCL Text Speed: 13.5 ppm
PCL Graphics Speed: 3.8 gppm
PS Text Speed: 13.5 ppm
PS Graphics Speed: 1.6 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 11.5 ppm
Lotus 1-2-3 for Windows: 4.3 gppm
CorelDRAW: 2.0 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 8.3 gppm
Lotus 1-2-3 for Windows: 2.4 gppm
CorelDRAW: 1.6 gppm



Dataproducts LZR2080

\$4,895

20-ppm B-size laser printer (Fuji-Xerox XP-20 engine) with 800- by 800-dpi output, Adobe PostScript Level 2, PCL 4

PCL Text Speed: 10.7 ppm
PCL Graphics Speed: 0.8 gppm
PS Text Speed: 12.2 ppm
PS Graphics Speed: 0.4 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 7.6 ppm
Lotus 1-2-3 for Windows: 0.7 gppm
CorelDRAW: 0.4 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 7.4 gppm
Lotus 1-2-3 for Windows: 1.0 gppm
CorelDRAW: 0.5 gppm



HP LaserJet 4Si MX

\$5,299

17-ppm laser printer (Canon LBP-NX engine) with 600- by 600-dpi output, Adobe PostScript Level 2, enhanced PCL 5

PCL Text Speed: 14.8 ppm
PCL Graphics Speed: 3.5 gppm
PS Text Speed: 14.2 ppm
PS Graphics Speed: 1.6 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 12.2 ppm
Lotus 1-2-3 for Windows: 4.0 gppm
CorelDRAW: 2.1 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 11.1 gppm
Lotus 1-2-3 for Windows: 2.7 gppm
CorelDRAW: 1.8 gppm



Digital PrintServer 17/600

\$4,695

17-ppm laser printer (Canon LPS17-A2 engine) with 600- by 600-dpi output, Adobe PostScript Level 2, PCL 5

PCL Text Speed: 10.7 ppm
PCL Graphics Speed: 1.1 gppm
PS Text Speed: Fail
PS Graphics Speed: Fail
PCL WINDOWS APPLICATIONS:
Word for Windows: 5.0 ppm
Lotus 1-2-3 for Windows: 1.5 gppm
CorelDRAW: 0.9 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: Fail
Lotus 1-2-3 for Windows: Fail
CorelDRAW: Fail
Fail—The printer could not complete the PostScript versions of our tests.



Lexmark IBM LaserPrinter 4039 16L Plus

\$3,399

16-ppm laser printer (Lexmark 4039 engine) with 600- by 600-dpi output, PostScript Level 2 clone, PCL 5a

PCL Text Speed: 13.4 ppm
PCL Graphics Speed: 3.4 gppm
PS Text Speed: 13.3 ppm
PS Graphics Speed: 1.4 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 9.1 ppm
Lotus 1-2-3 for Windows: 4.4 gppm
CorelDRAW: 1.7 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 10.3 gppm
Lotus 1-2-3 for Windows: 2.4 gppm
CorelDRAW: 1.7 gppm



HP LaserJet 4V

\$2,449

16-ppm B-size laser printer (Canon BX-2 engine) with 600- by 600-dpi output, Adobe PostScript Level 2 (optional), enhanced PCL 5

PCL Text Speed: 13.5 ppm
PCL Graphics Speed: 3.8 gppm
PS Text Speed: 13.5 ppm
PS Graphics Speed: 1.8 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 11.5 ppm
Lotus 1-2-3 for Windows: 4.3 gppm
CorelDRAW: 2.0 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 8.3 gppm
Lotus 1-2-3 for Windows: 2.4 gppm
CorelDRAW: 1.6 gppm



QMS 1660 Print System

\$4,100

16-ppm B-size laser printer (Canon LBP-BX engine) with 1,200- by 600-dpi output, PostScript Level 2 clone, PCL 5

PCL Text Speed: 13.8 ppm
PCL Graphics Speed: 2.8 gppm
PS Text Speed: 13.6 ppm
PS Graphics Speed: 1.8 gppm
PCL WINDOWS APPLICATIONS:
Word for Windows: 11.5 ppm
Lotus 1-2-3 for Windows: 2.1 gppm
CorelDRAW: 1.9 gppm
PS WINDOWS APPLICATIONS:
Word for Windows: 11.1 gppm
Lotus 1-2-3 for Windows: 3.6 gppm
CorelDRAW: 1.8 gppm



QMS 1725 SL\$ Print System

\$5,499

17-ppm B-size laser printer (Canon NX engine) with 600- by 600-dpi output, PostScript Level 2 clone, PCL 5

PCL Text Speed: 14.6 ppm
PCL Graphics Speed: 3.1 gppm
PS Text Speed: 14.8 ppm
PS Graphics Speed: 1.6 gppm
PCL WINDOWS APPLICATIONS
Word for Windows: 10.3 ppm
Lotus 1-2-3 for Windows: 2.7 gppm
CorelDRAW: 2.0 gppm
PS WINDOWS APPLICATIONS
Word for Windows: 11.1 gppm
Lotus 1-2-3 for Windows: 2.9 gppm
CorelDRAW: 1.6 gppm



Xerox 4520mp

\$5,199

20-ppm B-size laser printer (Fuji Xerox XP-20 engine) with 600- by 600-dpi output, Adobe PostScript Level 2, PCL 5e

PCL Text Speed: 17.0 ppm
PCL Graphics Speed: 3.4 gppm
PS Text Speed: 16.3 ppm
PS Graphics Speed: 1.7 gppm
PCL WINDOWS APPLICATIONS
Word for Windows: 13.3 ppm
Lotus 1-2-3 for Windows: 4.3 gppm
CorelDRAW: 2.0 gppm
PS WINDOWS APPLICATIONS
Word for Windows: 12.2 gppm
Lotus 1-2-3 for Windows: 3.2 gppm
CorelDRAW: 1.8 gppm

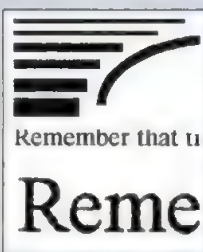


QMS 3225 Print System

\$19,995

32-ppm B-size laser printer (Ricoh M32 engine) with 400- by 400-dpi output, PostScript Level 2 clone, PCL 5

PCL Text Speed: 29.4 ppm
PCL Graphics Speed: 4.8 gppm
PS Text Speed: 27.8 ppm
PS Graphics Speed: 1.5 gppm
PCL WINDOWS APPLICATIONS
Word for Windows: 18.8 ppm
Lotus 1-2-3 for Windows: 3.3 gppm
CorelDRAW: 2.1 gppm
PS WINDOWS APPLICATIONS
Word for Windows: 19.4 gppm
Lotus 1-2-3 for Windows: 3.3 gppm
CorelDRAW: 1.9 gppm

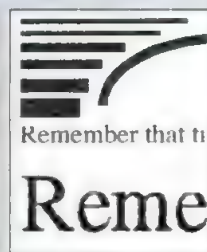


Xerox 4220

\$8,995

20-ppm B-size laser printer (Fuji Xerox P500 engine) with 300- by 300-dpi output, Adobe PostScript Level 2, PCL 5

PCL Text Speed: 15.5 ppm
PCL Graphics Speed: 2.0 gppm
PS Text Speed: 16.0 ppm
PS Graphics Speed: 1.5 gppm
PCL WINDOWS APPLICATIONS
Word for Windows: 12.2 ppm
Lotus 1-2-3 for Windows: 1.7 gppm
CorelDRAW: 1.3 gppm
PS WINDOWS APPLICATIONS
Word for Windows: 11.8 gppm
Lotus 1-2-3 for Windows: 2.1 gppm
CorelDRAW: 0.8 gppm



Xante Accel-a-Writer 8200

\$4,495

16-ppm B-size laser printer (Canon BX-2 engine) with 1,200- by 1,200-dpi output,* Adobe PostScript Level 2, PCL 5

PCL Text Speed: 12.9 ppm
PCL Graphics Speed: 3.3 gppm
PS Text Speed: 12.9 ppm
PS Graphics Speed: 1.0 gppm
PCL WINDOWS APPLICATIONS
Word for Windows: 7.7 ppm
Lotus 1-2-3 for Windows: 0.7 gppm
CorelDRAW: 0.8 gppm



* Maximum resolution requires a memory upgrade

up to B-size paper. B-size capability is also offered in the Dataproducts, the QMS 1660 and 3225, the Accel-a-Writer, and the new HP LaserJet 4V and 4MV, which can print full bleed on 11-by-17 paper. Digital, HP, QMS, and Xerox offer optional 1,500-sheet feeders,

number one in this area, with 1,200-dpi PostScript printing and the best PostScript graphics output. HP's LaserJets, at 600 dpi, were a close second and produced the most consistent quality output in all emulations. Also, an internal hard disk for holding fonts and logos can come in handy in a heavy graphics environment.

Network printers are more powerful and flexible than ever. Whatever the diverse needs of your network users, you can find a printer here that will handle them all.

Advanced Matrix Technology Inc.

• AMT TracJet III

BY STEVE RIGNEY

The AMT TracJet III is the only tractor-feed, continuous-form laser printer in this review. It is designed for high-volume, heavy-duty industrial work, like printing labels, bar codes, and stocking tags on different kinds of paper and material, including cloth, plastic, and even metal. It lists for \$6,995 (\$5,250 street) and provides 16-page-per-minute throughput and 300-dot-per-inch PCL 5

THE BASICS

While it's not as sexy as protocol switching or remote management, paper handling is still important to consider when purchasing any printer, most of all one that will be shared by several users. Look for a high monthly duty cycle that matches the needs of your department and hefty, flexible paper handling. The HP LaserJet 4Si MX comes standard with two 500-sheet standard paper cassettes—but if your network needs B-size paper, you'll have to look elsewhere. The Xerox 4220 offers three 250-sheet cassettes that take

and most printers here also offer optional envelope feeders.

Duplexing—the ability to print on both sides of a page—is offered as an option on five of the printers and is useful for keeping paper costs down. Another potential cost saver is Energy Star certification. Only the TracJet could not power down to Energy Star levels (under 45 watts for 15 ppm and above).

Finally, if your department does a lot of graphics printing, check out the maximum resolution and print quality of the printers reviewed here. The Accel-a-Writer is



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HP Printers



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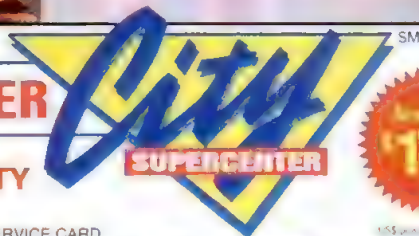


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emulation. AMT also offers an optional PostScript Level 2 emulator for \$995. If you have the optional PostScript emulator installed, the TracJet can automatically switch between PCL and PostScript print jobs.

The TracJet has no paper trays, but that's not a problem since you can use an entire box of continuous-form paper—usually around 2,500 or 5,000 sheets—before reloading the printer. You can also print a single form up to 33 inches long.

The TracJet III takes longer to assemble than most lasers because of its tractor feed, but changing forms and performing maintenance on the printer is very easy. The TracJet's straight-through paper path all but eliminates paper jams. AMT does not offer its own network interface card; nor does it provide any special printer drivers or software for configuring or remote monitoring the TracJet. The TracJet does work with several internal and external network interfaces from Extended Systems, however.

Though the TracJet was able to complete our Graphics Speed and Microsoft Windows applications tests, it is not designed for high-quality graphics and comes standard with only 4MB of RAM (expandable to 13MB). It's not a very fast printer compared with others in this review, averaging only 13.4 ppm in PCL mode and 11.0 ppm in PostScript mode.

If you need to print continuous forms or labels but also need the quality of a laser printer, the TracJet is definitely worth a look.

► **AMT TracJet III.** List price: \$6,995; *PostScript Level 2*, \$995. Advanced Matrix Technology Inc., 765 Flynn Rd., Camarillo, CA 93012-8077; 800-992-2264, 805-388-5799; fax, 805-484-3087.

Circle 483 on reader service card



Dataproducts Corp.

• Dataproducts LZR2080

BY STEVE RIGNEY

The Dataproducts LZR2080 combines the company's own Virtual Printer Technology (VPT) with support for multiple network protocols in a versatile network printer. Rated at 20 pages per minute, the Dataproducts comes with PCL 4 and PostScript Level 2 emulations and resolutions of up to 800 by 800 dots per inch (400 by 400 in PCL). It lists for \$4,895 and offers

two 250-sheet multipurpose paper cassettes and network interfaces for Ethernet or LocalTalk. A base configuration with only one paper cassette and a parallel port (but no network interface) is available for \$4,295.

Virtual Printer Technology allows you to configure different default resolutions, paper sizes, and emulations for each of up to 64 workgroup or individual users on your LAN. For example, secretaries on the LAN may think they're printing to a 400-dpi PCL 4 printer with letter-size paper while a graphic artist

seems to print to an 800-dpi B-size PostScript printer and the accountant uses a PCL 4 landscape printer with legal-size paper. VPT is also an SNMP management utility that a network administrator can use to monitor and control

multiple printers remotely from a central location, and it provides usage tracking for each virtual printer. To use the remote-management features, however, you must connect to the printer using a terminal emulation program.

You need PCONSOLE to configure the print queues on your NetWare LAN. Installation is fairly straightforward, but we had to call technical support for help due to some omissions in the manual.

Although the printer has a rated speed

of 20 ppm, our performance tests only showed 10.7 text ppm in PCL and 12.2 ppm in PostScript. Graphics performance was a slow 0.6 graphics pages per minute in PCL and 0.4 gppm in PostScript. Microsoft Windows applications test scores were similarly slow. Note that the Dataproducts, like the Digital PrintServer 17/600, comes without a parallel port; we had to run tests over the network. All other printers were tested over their parallel ports. The Dataproducts did poorly on our Network Speed test, taking 28 minutes 53 seconds to print our PCL and PostScript files. At 800 dpi, print quality was excellent, with crisp, dark text and excellent gray-scale graphics.

The Dataproducts is available with one, two, or three 250-sheet multipurpose paper cassettes that accept up to B-size paper and several optional cassettes. You can configure the cassettes to cascade, or you can set up individual cassettes for different types of paper and even different users or workgroups.

► **Dataproducts LZR2080.** List price: \$4,895; 4MB RAM upgrade, \$365; 8MB RAM upgrade, \$695; multipurpose feeder (holds 100 sheets or 15 envelopes), \$370; twisted-pair Ethernet interface card, \$75; thin-wire Ethernet interface, \$85; PostScript fax modem, \$399. Dataproducts Corp., 6219 Desoto Ave., Woodland Hills, CA 91367; 800-980-0374, 818-887-8000; fax, 818-887-8084.

Circle 484 on reader service card

Digital Equipment Corp.

• Digital PrintServer 17/600

BY STEVE RIGNEY

With a retail price of \$4,695, the Digital PrintServer 17/600 is designed for medium-size to small departmental LANs that run over several protocols and print both



Fewer Walks down the Hall

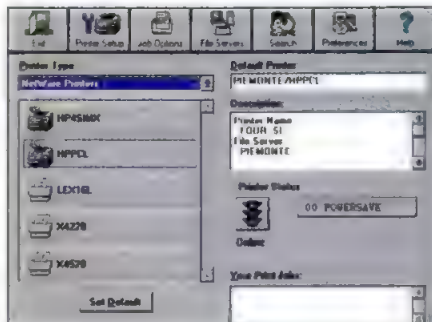
By Jonathan Hill

Anyone who has printed on a network knows how frustrating it can be to start a print job, then walk down the hall to find that the output was rendered useless because the wrong emulation was set on the printer or someone had changed the paper type. And most network administrators know that until recently, printer support in NetWare was so primitive that setting up and maintaining servers and queues in a medium-sized office was almost a full-time job.

Now that network printers come with bidirectional parallel ports and network interface cards, printer vendors have begun addressing these and other printer management problems with remote management utilities. Most of these utilities use bidirectional communications to alert end users at their PCs to paper out, toner low, and other specific printer conditions. Some also let users choose paper trays and modify the printer control panel remotely. Utilities also give administrators the ability to configure, manage, and troubleshoot several printers on the network.

Hewlett-Packard's remote management software, one of the best current implementations, is divided into separate JetPrint and JetAdmin modules. JetPrint's series of drop-down menus, buttons, and icons, lets users with appropriate access rights attach to any available network file server or printer and reorder, reprioritize, delete, or

otherwise manipulate job entries. For HP's own printers only, JetPrint offers visual and audio alerts for printer status messages, downloading of available drivers, drag-and-drop printing, and a graphical depiction of the printer's



HP's JetPrint Utility lets users attach to any networked printer by clicking on its icon.

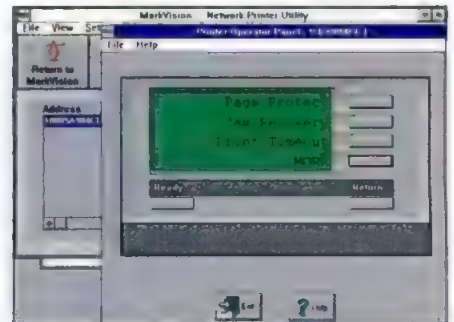
front panel. Unlike Lexmark's MarkVision, however, the graphical control panel's buttons are not active.

JetAdmin provides detailed diagnostic information for network administrators, centralized Windows-based driver installation, and the ability to remotely diagnose and configure HP's JetDirect network interface cards. Advanced features give users the ability to lock HP printer control panels, prevent changes to HP printer configurations, edit the Queue Server Job Poll rate, and reset network protocol stacks.

RIGHT ON THE MARK

Lexmark's Windows-based MarkVision software goes a step further, providing a graphical re-creation of the Lexmark

4039-series' well-organized printer control panels on your monitor screen, complete with active buttons that you can click on to set any function that can be accessed from the printer panel itself. Thus, using the software to



Lexmark's MarkVision provides graphical depictions of the excellent control panels.

change the Print Timeout follows the same logical menu structure as the front panel on the printer.

MarkVision also provides remote access to printer status (including fonts, emulations, and printer attachments), and a long list of voice messages in response to various error conditions. Diagnostics, if not quite as robust as HP's implementation, are nonetheless quite adequate.

XEROX'S DSP

Xerox has updated its DOS-based printer management software with a combination of Windows- and DOS-based utilities called Xerox Document Services for Printing (DSP). Much of the functionality of the printer's front

text and graphics. It runs over NetWare, TCP/IP, and Microsoft Windows NT networks with automatic protocol switching. Rated at 17 pages per minute, the PrintServer 17/600 features PCL 5 and PostScript Level 2 emulations at 300 and 600 dots per inch, respectively.

The combination of emulation and protocol switching makes the PrintServer very versatile. For example, it can handle a PostScript document from a Macintosh running

Digital's Pathworks and a PCL 5 document from a NetWare client PC simultaneously on the same LAN. Unfortunately, the PrintServer's versatility is not matched by compatibility or ease of installation.

Using Digital's PostScript Windows driver, the PrintServer produced crisp text and finely detailed graphics with smooth gray scaling at 600 dpi. But it was unable to produce text in PostScript mode on our Text Speed test or true Adobe

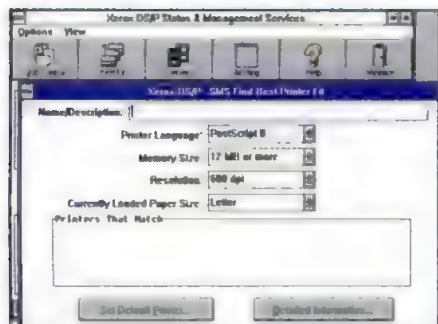
PostScript Level 2 images on our DOS-based Graphics Speed test, which indicates less than 100 percent compatibility.

Installation is fairly straightforward but complicated by the fact that Digital provides its own print server NetWare Loadable Module that communicates with the printer via TCP/IP. If you don't have a working knowledge of your network and TCP/IP, you may run into problems.

Like the Dataproducts LZR2080, the

panel is contained within the DOS-based RUI (Remote User Interface), although these services are not contained within a depiction of the front panel.

More interesting are the extra features of the Windows-based DSP Status and Management Services (SMS). SMS's Best Fit utility allows the user to search across the network by printer



Xerox Document Services for Printing helps you find the right printer for your print job.

name or feature set for the printer that best matches a particular print job or to let SMS do so automatically. For example, you can look for a PostScript printer with 11 by 17 paper or you can let SMS analyze your print job and look for you.

More important perhaps to network administrators and cost control centers are the report-generation features available under SMS's Accounting. Administrators can monitor printer usage and error logs using the software, and company overseers can view and generate cost reports for individuals and groups of users, vastly simplifying client billing and departmental accounting. These advanced features work only for 4500 series of Xerox

PrintServer does not come with a parallel port; speed tests had to be run over the network, which yielded poor scores due mostly to network overhead. On our Network Speed test, in which all the printers are tested over the network, the PrintServer's score of 6 minutes 50 seconds was average.

You can use a terminal emulator connected directly to the printer or to a TCP/IP program such as Novell's LAN

printers; neither older Xerox units (such as the 4220) nor other vendors' products can be accessed properly for the reports.

GETTING IT TOGETHER

These examples illustrate both the promise of standardized access to network peripherals and the immaturity of today's solutions. The features are robust, but each remote management utility has its own individual interface and works only partially or not at all with printers from other vendors.

Leading network computer vendors have started attacking these and other compatibility problems by forming the Desktop Management Task Force, whose purpose is to develop a common remote management system (called the Desktop Management Interface, or DMI). Another committee called the Printer Working Group is writing a standard database of printer features that can be manipulated remotely (called a Management Information Base, or MIB) using SNMP (Simple Network Management Protocol). The printer DMI and MIB are not yet finalized (the current schedule calls for final ratification by the end of this year), but they are clearly influencing the current crop of network lasers.

The DMTF has also developed a MIF (Management Information Format), similar to the MIB, for managing desktop printers attached to PCs on the network. The ultimate goal is to let software from network printing vendors work with printers from any manufacturer. □

Workplace to check the condition of the printer and perform basic maintenance tasks. Digital's Windows driver also provides remote control of paper trays, emulations, and duplexing and alerts the user when the printer is off-line or out of paper. Another software utility allows the administrator to detect jams and low toner conditions.

► **Digital PrintServer 17/600.** List price: \$4,695; 4MB RAM upgrade, \$395; 8MB

RAM upgrade, \$695; 1,500-sheet input tray, \$585; 3,000-sheet output stacker, \$1,195; duplexer, \$635. Digital Equipment Corp., 146 Main St., Maynard MA, 01745-2571; 800-777-4343, 508-493-5111; fax, 800-234-2298.

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Hewlett-Packard Co.



EDITORS' CHOICE

HP LaserJet 4Si MX

BY JONATHAN HILL

An Editors' Choice recipient for the second year in a row, the HP LaserJet 4Si MX (\$5,299 list, \$4,550 street) does everything you'd ask a departmental laser to do except print on B-size paper. It's fast and quiet and comes standard with a bidirectional parallel port and network interfaces supporting LocalTalk and either Ethernet (10BaseT and 10Base2) or Token-Ring. It also switches automatically between enhanced PCL 5 and PostScript Level 2 at 600 dots per inch, has a respectable 75,000-page-per-month duty cycle, and comes with some of the best remote-management software around. If



you don't need PostScript and can wait on a network adapter, the HP LaserJet 4Si (\$3,749 list, \$2,899 street) is PCL-only and has a slot for an optional network adapter (\$369 for Ethernet, \$619 for Token-Ring).

Setting up the LaserJet 4Si MX is a snap—HP's installation software steps you through the entire process. Once installed, HP's JetPrint utility provides drag-and-drop printing within Microsoft Windows, automatic driver installation, sound-enabled error messaging, status information through a graphical depiction of the front panel, and easy selection of any accessible network printer queue. Windows-based JetAdmin utilities allow administrators to lock the front panel,

configure the JetDirect network card, and fine-tune various network parameters.

The LaserJet 4Si MX's I/O ports are all active simultaneously, and the JetDirect network interface can support multiple simultaneously active protocols, including EtherTalk, various NetWare IPX/SPX frame types, TCP/IP, and Microsoft LAN Manager (DLC/LLC) or OS/2 LAN Server. SNMP is supported using IP or IPX.

Print quality was first-rate, and the unit's speed printing text and graphics was well above average. On our Network Speed test, the LaserJet 4Si MX came in second at 2 minutes 55 seconds. It has two letter-size 500-sheet paper cassettes; a 1,500-sheet letter-size tray is optional. This is a top-quality product with few flaws. If you really need B-size printing, wait for the new HP LaserJet 4V and 4MV (profiled in the sidebar below).

► **HP LaserJet 4Si MX.** List price: \$5299. 1,500-page paper feeder, \$649; additional 500-sheet cassettes, \$129 each; envelope feeder, \$480; 2,000-page output stacker, \$950; duplex unit, \$670; HP JetDirect Ethernet card, \$369; HP JetDirect Token-Ring card, \$619; printer cabinet, \$420. Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 5801, Steven's Creek Blvd., Santa Clara, CA 95051-8059; 800-752-0900,

208-396-2551; fax, 800-333-1917.

Circle 486 on reader service card

Lexmark International Inc.

■ IBM LaserPrinter 4039 16L Plus

BY JONATHAN HILL

The \$3,399 (\$2,899 street), 600-dot-per-inch IBM LaserPrinter 4039 16L Plus combines impressive expandability with Lexmark's top-notch MarkVision remote-control software and a 16-page-



per-minute, 32-bit RISC-based engine to provide an excellent general-purpose departmental printer.

Though identical in appearance to the IBM LaserPrinter 4039 12L Plus (reviewed in this issue in the Personal/Work-

group Lasers section), the 16L Plus is based on a faster RISC processor (the 20-MHz AMD Am29000) and has a longer duty cycle (up to 75,000 pages per month). It does share the 12L Plus's Energy Star compatibility, expansion options, and automatic emulation-switching technology. Print quality was decent using Lexmark's PQET (Print Quality Enhancement Technology), but banding was visible in PostScript gray-scale graphics and PCL output was on the dark side. Performance on our speed tests was about average for a 16-ppm printer, but the Lexmark's Word for Windows score in 600-dot-per-inch PostScript was a painfully slow 5.4 ppm. On our Network Speed test, the Lexmark's score of 8 minutes 57 seconds was the second worst of the batch—though it was considerably better than the Dataproducts LZR2080's 28 minutes 53 seconds.

MarkVision, a Microsoft Windows-based application, uses the 16L Plus's bidirectional parallel port to allow access to the printer's control panel. In combination with an internal network adapter (our unit came equipped with Lexmark's \$499 MarkNet XL 10BaseT adapter), MarkVision's bidirectional network utilities also provide status and configuration information, control panel access, and dri-

■ Preview: The Tabloid-Size HP LaserJet 4V and 4MV

Hewlett-Packard has filled in one of the few cracks in its coverage of the laser printer market with the introduction of its mid- to high-end LaserJet 4V and 4MV models. Based on an updated version of HP's 16-ppm, 600-dpi, print engine, which has an i80960 controller, the units are slightly faster than their 4Si cousins. They have B-size print capability and offer an optional internal hard disk—all for \$1,750 to \$2,850 less than an equivalently outfitted 4Si. The key to understanding their place in the HP pantheon is the company's description of them as workgroup lasers, as opposed to the departmental 4Si and 4Si MX. The relative cost savings is achieved at the expense of a lower duty cycle—35,000 pages for the 4V and 4MV versus 75,000 pages for the 4Si and 4Si MX.

The HP LaserJet 4V comes with 4MB of RAM and supports HP PCL 5e and HP GL/2; the 4MV adds another 8MB and PostScript Level 2. Both units ship with HP's Bi-Tronics (bidirectional) parallel port. The 4MV adds HP's JetDirect Network I/O card for Ethernet and LocalTalk connectivity; the 4V offers it as an option.

HP has added several features to its excellent JetPrint and JetAdmin software, including asset management and automatic driver configuration. All printer ports are active simultaneously; automatic language sensing and multiple active network protocol stacks round out the units' connectivity features.

Perhaps the most intriguing feature of the 4V and 4MV printers is their introduction of full-bleed 11-by-17

capability, which enables revision marks to be placed outside of the standard 11-by-17 print area for DTP and CAD work.

► **HP LaserJet 4V.** List price: \$2,449; 500-sheet universal input tray, \$449; 8MB SIMM, \$579; 42MB hard disk, \$499; Adobe PostScript Level 2 SIMM, \$499; HP JetDirect Ethernet/10BaseT/10Base2 interface card, \$369; HP JetDirect Token Ring interface card, \$619.

► **HP LaserJet 4MV.** List price: \$3,549; 500-sheet universal input tray, \$579; 42MB hard disk, \$499; HP JetDirect Token Ring interface card, \$619. Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 5801, Steven's Creek Blvd., Santa Clara, CA 95051-8059; 800-752-0900, 208-396-2551; fax, 800-333-1917.

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Conceptual design by Robert F. Humerick and Jerry D. Flynn of McDonnell Douglas Space Systems

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CIRCLE 048 ON READER SERVICE CARD

► **S U M M A R Y O F F E A T U R E S**

Departmental Lasers

PC MAGAZINE
EDITORS' CHOICE

In alphabetical order by company

■ = YES □ = NO

	Advanced Matrix AMT TracJet III	Dataproducts LZR2080	Digital PrintServer 17/600	HP LaserJet 4V	HP LaserJet 4MV	HP LaserJet 4Si MX	Lexmark IBM LaserPrinter 4039 16L Plus
List price (base configuration)	\$6,995	\$4,895	\$4,695	\$2,449	\$3,549	\$5,299	\$3,399
Dimensions (HWD, in inches)	7.3 x 18 x 20.5	12.5 x 20 x 21	19 x 17.9 x 22.4	12.5 x 18.1 x 20.6	12.5 x 18.1 x 20.6	16.5 x 21.7 x 29.9	16 x 14.9 x 21
Engine model	Pentax PL-0301	Fuji Xerox XP-20	Canon LPS17-A2	Canon BX-2	Canon BX-2	Canon LBP-NX	Lexmark 4039
Processor	16-MHz Intel i80960CF or Intel i80961CF	7.5-MHz Witek 8200	114-MHz SOC	33-MHz Intel i80960CF	33-MHz Intel i80960CF	25-MHz Intel i80960CF	20-MHz AMD Am29000
Instruction set	RISC	RISC	CISC	RISC	RISC	RISC	RISC
Rated engine speed (pages per minute)	16	20	17	16	16	17	16
Toner capacity (number of copies)	8,000	11,000	8,000	8,100	8,100	10,250	10,000
Standard, maximum RAM	4MB, 13MB	8MB, 32MB	16MB, 32MB	4MB, 68MB	12MB, 44MB	10MB, 26MB	4MB, 16MB
Interfaces							
Parallel/serial port	■ ■	□ ■	□ □	■ ■	■ ■	■ □	■ ■
Bidirectional/ECP parallel support	□ □	□ □	□ □	■ □	■ □	■ □	■ □
LocalTalk/SCSI port	□ □	■ ■	□ □	Optional □	Optional □	■ □	Optional □
Automatic interface switching	■	□	□	■	■	■	■
Simultaneously active ports	■	■	□	■	■	■	■
Paper Handling							
Capacity of each standard cassette (sheets)	N/A	250 (multipurpose), 250 (multipurpose)	500 (multipurpose), 500 (multipurpose)	250 (letter), 100 (letter)	250 (letter), 100 (multipurpose)	500 (letter), 500 (multipurpose)	500 (letter)
Duplexing/Prints on B-size paper	□ □	□ ■	Optional □	□ ■	□ ■	Optional □	Optional □
Rated maximum paper weight (pounds)	24	24	24	28	28	28	24
Rated duty cycle (pages per month)	50,000	50,000	70,000	35,000	35,000	75,000	75,000
Fonts and Features							
Automatic emulation switching	■	□	■	■	■	■	■
PCL support	PCL 5	PCL 4	PCL 5	Enhanced PCL 5	Enhanced PCL 5	Enhanced PCL 5	PCL 5e
Maximum resolution in PCL (dpi)	300 x 300	400 x 400	300 x 300 ②	600 x 600	600 x 600	600 x 600	600 x 600
PostScript support	Level 2 clone (optional)	Adobe Level 2	Adobe Level 2	Adobe Level 2 (optional)	Adobe Level 2	Adobe Level 2	Level 2 clone
Maximum resolution in PostScript (dpi)	300 x 300	800 x 800	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600
Number of Type 1 fonts	35	35	43	35	35	35	39
Other emulations	None	None	IBM Proprinter, ReGIS, Tektronix 4010, Tektronix 4014	HPGL/2	HPGL/2	None	None
Resolution enhancement	□	■	■	■	■	■	■
Hard disk capacity and interface	N/A	N/A	N/A	42MB SCSI	42MB SCSI	N/A	40MB IDE (optional)
Network Support							
Internal Ethernet/Token-Ring	□ □	■ □	■ □	Optional □	Optional ■	■ □	Optional □
Automatic protocol switching	□	■	■	■	■	■	■
Remote status messages	□	■ ⑤	■	■	■	■	■
Remote paper-tray selection	□	■	■	■	■	■	■
Remote configuration/troubleshooting	□ □	■ ⑤ ⑥ ⑦	■ ■	■ ■	■ ■	■ ■	■ ■
Remote modification of control panel by end user/administrator	□ □	□ ■ ⑤	■ ■	□ ■	□ ■	□ ■	■ ■
Control-panel lock	□	□	■	■	■	■	■
Customer Support							
Toll-free technical support	■	□	■	■	□	□	□
Telephone support hours (eastern time)	8:00-5:00 M-F	10:30-7:30 M-F	24 hours, 7 days	9:00-8:00 M-F	9:00-8:00 M-F	9:00-8:00 M-F	10:00-7:00 M-F
Warranty (parts and labor)	1 year	1 year	1 year	1 year	1 year	1 year	1 year

N/A--Not applicable. The product does not have this feature.

① This product is profiled in a sidebar and is not reviewed separately.

② PCL 5 supports 600-by-600 resolution for line art in HPGL mode and text.

③ Using the maximum resolution requires additional RAM.

④ The function can be accessed only with a terminal emulation program.

⑤ The Ethernet adapter and software run only over TCP/IP and EtherTalk networks.

ENDS

PC MAGAZINE
EDITORS' CHOICE

QMS 1660 PrintSystem	QMS 1725 SLS Print System	QMS 3225 Print System	Xante Accel-a-Writer K200	Xerox 4520mp	Xerox 4420mp
\$4,199	\$5,499	\$19,995	\$4,495	\$5,199	\$8,995
11.8 x 18 x 23.2	19 x 21.6 x 22.4	29.5 x 37.4 x 25.8	11.7 x 17.9 x 20.3	21 x 20 x 16.4	41.7 x 39 x 21.6
Canon LBP-BX	Canon NX	Ricoh M32	Canon BX-2	Fuji Xerox XP-20	Fuji Xerox P500
33-MHz IDT 3081	25-MHz Intel i80960CF	33-MHz IDT 3081E	33-MHz AMD Am29030	25-MHz AMD Am29030	20-MHz AMD Am29000
RISC	RISC	RISC	RISC	RISC	RISC
16	17	32	16	20	20
7,500	8,000	20,000	7,500	14,000	15,000
12MB, 64MB	13MB, 32MB	16MB, 32MB	12MB, 64MB	8MB, 52MB	8MB, 20MB
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	□ □	□ □	□ ■	■ □	■ □
■ Optional	■ ■	■ ■	■ ■	Optional □	Optional □
■	■	■	■	■	■
■	■	■	■	■	■
250 (letter), 100 (multipurpose)	500 (A4, letter, or both), 500 (A4, letter, or both)	250 (B-size), 250 (letter)	250 (B-size), 250 (letter), 100 (multipurpose)	250 (letter), 250 (letter), 250 (letter)	250 (letter), 250 (letter), 250 (letter)
□ ■	Optional □	Optional ■	□ ■	□ ■	■ ■
34	36	24	34	36	110
10,000	75,000	200,000	10,000	50,000	25,000-100,000
■	■	■	■	■	■
PCL 5	PCL 5	PCL 5	PCL 5	PCL 5e	PCL 5
300 x 300 ②	300 x 300 ②	400 x 400	600 x 600	800 x 800 ③	300 x 300
Level 2 clone	Level 2 clone	Level 2 clone	Adobe Level 2	Adobe Level 2	Adobe Level 2
1,200 x 600 ③	600 x 600	400 x 400	1,200 x 1,200 ③	800 x 800 ③	300 x 300
39	39	39	35	35	35
HPGL, line printer, LN03 Plus (optional), QUIC 2 (optional)	CCITT Group 4, HPGL/2, line printer, 7550A	CCITT Group 4, HPGL/2, line printer	HPGL	None	None
□	□	□	■	■	■
127MB IDE (optional)	120MB SCSI	170MB SCSI	N/A	125MB IDE (optional)	200MB IDE (optional)
Optional Optional	Optional Optional	Optional Optional	Optional ④ □	■ Optional	Optional Optional
■	■	■	■ ⑤	■	□
■	■	■	■ ⑤	■	■
■	■	■	■ ⑤	■	■
■ ■	■ ■	■ ■	■ ⑤ ■ ⑤	■ ■	■ ■
■ ■	■ ■	■ ■	□ □	■ ■	■ ■
■	■	■	□	□	□
□	□	□	■	■	■
7:00 A.M.- 8:00 P.M. M-F	8:00-5:00 M-F	8:00-5:00 M-F	6:00-6:00 M-F	8:00-8:00 M-F	8:00-8:00 M-F
1 year	2 years	3 months	1 year	1 year	1 year

ver setup utilities for all 4039-based printers on your local or remote NetWare network. The 16L Plus comes with one 500-page letter-size paper cassette. Legal-size cassettes are available, but there is no B-size printing. An external unit, the IBM 4033 LAN Connection, is required to support multiple network topologies. Owners of older IBM 4039 laser printers can upgrade to the 16L Plus for \$359.

► **IBM LaserPrinter 4039 16L Plus.** List price: \$3,399; 4MB RAM upgrade, \$299; 8MB RAM upgrade, \$499; 1MB flash memory upgrade, \$289; 2MB flash memory upgrade, \$469; 4MB flash memory upgrade, \$799; 40MB hard disk space, \$799; PCL 5 Scannable font card, \$239; 500-page letter-size paper cassette, \$349; 500-page legal-size paper cassette, \$359; 75 envelope feeder, \$349; 300-page duplexer, \$499; MarkNet XL 10BaseT adapter, \$499; MarkNet XL 10Base2 adapter, \$549; MarkNet XL Token-Ring adapter, \$699; maintenance kit, \$399. Lexmark International Inc., 740 New Circle Rd. N.W., Lexington, KY 40511-1876; 800-358-5835, 606-232-2000; fax, 606-232-2380.

Circle 487 on reader service card

QMS Inc.

- **QMS 1660 Print System**
- **QMS 1725 SLS Print System**
- **QMS 3225 Print System**

BY STEVEN C. M. CHEN

Three printers from QMS offer a powerful combination of versatility and upgradability. An Editors' Choice winner last year, the QMS 3225 Print System (\$19,995 list) is a 32-page-per-minute workhorse with a duty cycle of 200,000 pages per month. It can serve 100 users or more with B-size output and 400-dot-per-inch PCL 5 and QMS Level 2 PostScript emulation. The QMS 1725 SLS (\$5,499 list) is an upgrade from last year's QMS 1725 Print System; it offers the same 17-ppm rating, 75,000-page-per-month duty cycle, and 600 dpi but adds PCL 5 emulation and a Software Loadable System (SLS) that stores operating code on the 40MB hard disk, letting you upgrade via floppy. (The QMS 3225 and 1660 have upgradable flash memory.) The brand-new, 16-ppm QMS 1660 Print System, list-priced at \$4,199, offers 1,200-by-600 PostScript res-

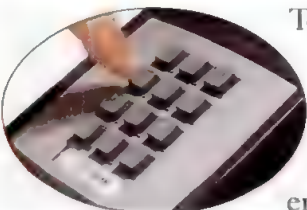


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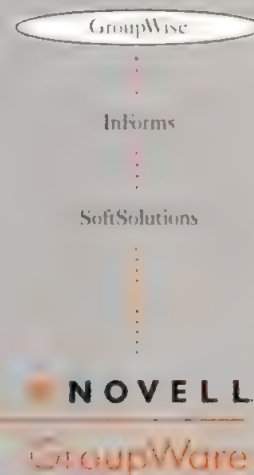
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Departmental Lasers

olution, a 10,000-page-per-month duty cycle, and B-size printing.

All three units employ QMS's Crown architecture, which can simultaneously process multiple print jobs from all ports regardless of each job's printer language. Optional RISC-based Ethernet or Token-Ring network interface cards can automatically switch between EtherTalk, Microsoft Lan Manager, NetWare, OS/2 LAN Server, and TCP/IP. You can also add a second Ethernet or Token-Ring card to the QMS 1660.

You can use either the included DOS-based utility or the printer's control panel to configure the NICs. Remote-management software will be available, but it did not arrive in time for our review.

The QMS 3225 has not changed since

last year except for a hard drive upgrade from 40MB to 170MB. About the size of a standalone departmental copier, it comes standard with 16MB of RAM (upgradable to 32MB), a floppy disk drive, and two 250-page paper cassettes (one letter-size, one B-size). A combination duplexer/1,000-page feeder/printer table (\$3,495) increases its capacity to 1,500 pages.



QMS 3225 Print System

Few printers come close to the QMS 3225's awesome text speed. It was the fastest of this year's group, with 29.4 ppm in PCL mode and 27.8 ppm in PostScript. PCL graphics printed at a fast 4.8 ppm on our Graphics Speed test, but the 1.5-ppm PostScript graphics score was only average—as were its scores on our Lotus 1-2-3 for Windows and CorelDRAW tests. The QMS 1725 SLS comes with 13MB of

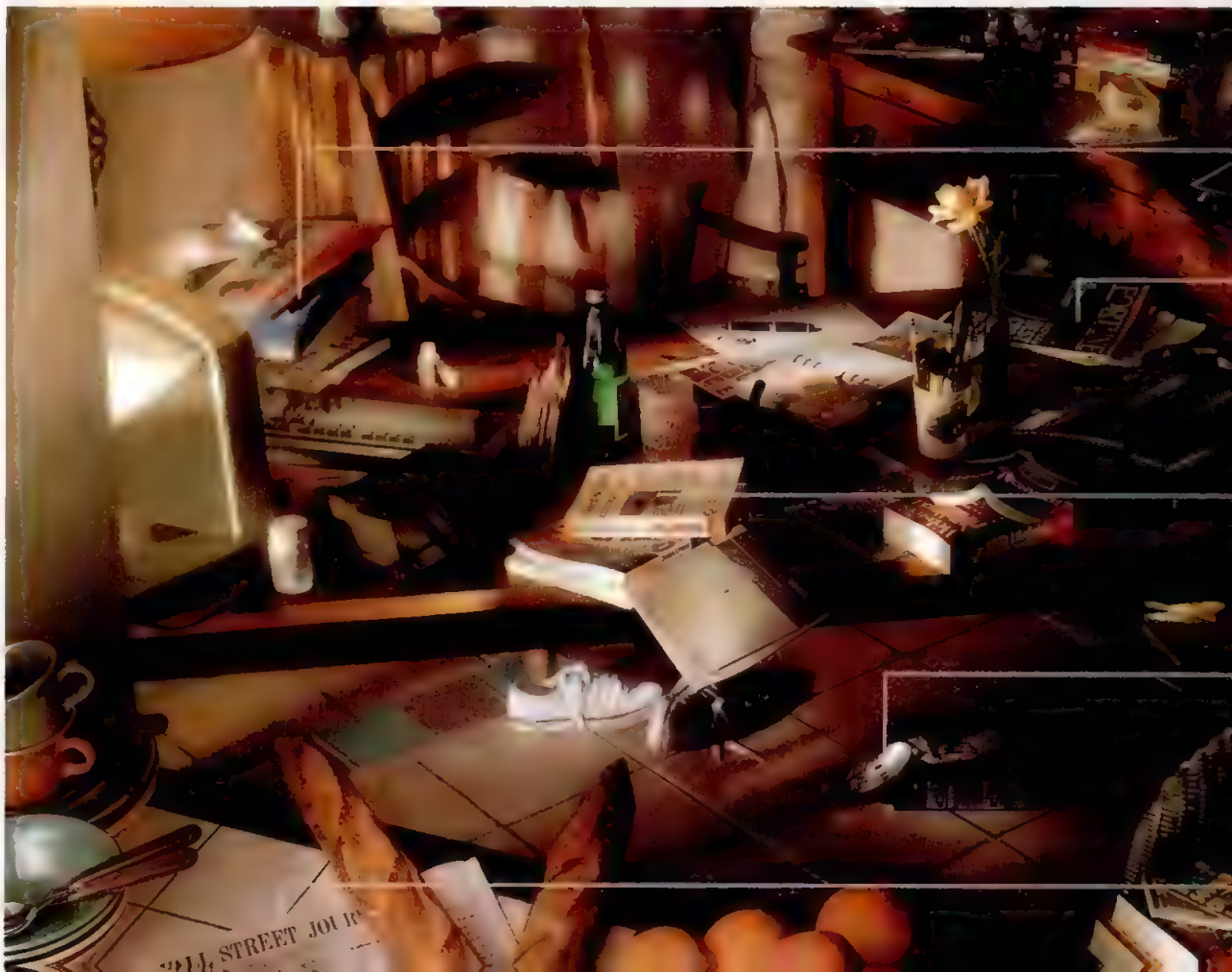
RAM (upgradable to 32MB), but adding memory or a network interface card is a clumsy procedure that requires removing a tray at the bottom of the printer. The QMS 1725 SLS was also fast at printing text and tied the HP LaserJet 4Si MX at 14.6 ppm. Graphics scores were average at 1.6 ppm in PostScript mode. Print quality is sharp for both text and graphics in 600-dpi PostScript, but it diminishes under PCL, which is limited to 300 dpi.

The QMS 1660 comes standard with one 250-sheet letter-size paper tray; an additional tray can be added that holds 250 sheets of legal-, letter-, or B-size. With a supporter attached, this extra tray can hold 500 sheets of letter- or legal-size paper. Like its siblings, the QMS 1660 posted top-notch text scores; unlike its siblings, its graphics scores were also fast for a 16-ppm printer—1.8 gppm on both Graphics Speed and CorelDRAW tests under PostScript. PostScript output is excellent in 1,200- by 600-dpi resolution.

► **QMS 1660 Print System.** List price: \$4,199; 4MB RAM upgrade, \$299; 8MB RAM upgrade, \$599; 16MB RAM up-



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grade, \$1,299; 32MB RAM upgrade, \$2,699; 45MB external hard disk, \$999; 127MB IDE hard disk kit, \$599; 250-sheet letter-, legal-, and A4-size cassette, \$99; 500-sheet letter-, legal-, and A4-size cassette, \$129; 250- or 500-sheet paper feeder, \$599; toner/developer/drum unit, \$199; IDE/SCSI adapter board, \$199; CrownNet Ethernet card, \$599; CrownNet Token-Ring card, \$649. **QMS 1725 SLS Print System.** List price: \$5,499; 8MB RAM upgrade, \$599; duplex option, \$599; additional 250-sheet paper cassettes, \$129 each; 1,500-sheet paper feeder, \$695; 100-envelope feeder, \$449; toner/developer/drum unit, \$169; CrownNet Ethernet card, \$799; CrownNet Token-Ring card, \$899. **QMS 3225 Print System.** List price: \$19,995; 8MB RAM upgrade, \$799; 45MB external hard disk, \$999; 1,000-sheet input bin/duplexer/system table, \$3,495; adjustable letter- to B-size cassette, \$120; 250-sheet adjustable letter-, legal-, or A3-size cassette, \$135; POC drum kit, \$390; toner kit, \$155; CrownNet Ethernet card, \$799; CrownNet Token-Ring card, \$899; cleaning kit, \$142. QMS Inc., P.O. Box 81250,

Mobile, AL 36689-1250; 800-523-2636, 205-633-4300; fax, 205-633-4866.

Circle 488 on reader service card

Xante Corp.

● Xante Accel-a-Writer 8200

BY JAMES KARNEY

With genuine Adobe PostScript Level 2, 1,200-dot-per-inch maximum resolution, and the ability to print edge-to-edge (up to 11.7 by 24.9 inches) on 11-by-25-inch paper, the Xante Accel-a-Writer 8200 is aimed at demanding applications such as desktop publishing and engineering. The 600-dpi, \$4,495 base configuration comes with an AMD Am29030 RISC processor; a built-in SCSI adapter for an external hard disk; simultaneously active serial, parallel, and AppleTalk interfaces; and 12MB of RAM. Fully loaded (\$8,795 list), the Accel-a-Writer offers 64MB of RAM and 1,200-dpi effective resolution. You can also get 1,200 dpi with 40MB of RAM for \$6,995. An intermediate 800-dpi solution with 20MB of RAM lists for \$5,295.



Xante Accel-a-Writer 8200

An optional Ethernet adapter is available for the Accel-a-Writer (\$395), as is remote-management software—but at the time of testing, they were only available for TCP/IP and EtherTalk environments. DOS and Microsoft Windows-based software for NetWare environments should be available in late 1994. The menu and LEDs on the printer could be improved; choosing a selection required several steps, and the process was not intuitive.

The Accel-a-Writer's output at 1,200 dpi was exceptional: Type was crisp, and halftones showed excellent gray scaling and very fine detail. Using Xante Corp.'s

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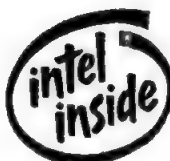
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Halftone Calibration Technology, you can manually control a halftone's gamma curve to lighten mid-tone ranges or the entire image. Xante offers a high-resolution toner that should be used for maximum quality, especially with halftone images.

Rated at 16 pages per minute, the Accel-a-Writer showed below-average performance. It managed only about 13 text ppm on our Text Speed test, about 1.0 graphics ppm on our Graphics Speed test, and 0.8 gppm on our CorelDRAW test.

► **Xante Accel-a-Writer 8200.** List price: \$4,495; 800-dpi version, \$5,295; 1,200-dpi version with 40MB RAM, \$6,995; 4MB RAM upgrade, \$300; 16MB RAM upgrade, \$1,200; 250-sheet letter-, legal-, or B-size paper cassette, \$89; 500-sheet letter- or A4-size tray, \$99; paper feeder, \$395; cassette supporter, \$69; Ethernet adapter, \$395. Xante Corp., 2559 Emogene St., Mobile, AL 36606; 800-926-8839, 205-476-8189; fax, 205-476-9421.

Circle 489 on reader service card

Xerox Corp.

EDITORS' CHOICE Xerox 4520mp

• Xerox 4220

BY JAMES KARNEY

Xerox Corp. offers two versatile network laser printers for two different environments. With its 100,000-page-per-month duty cycle, the 300-dot-per-inch Xerox 4220 is a heavy-duty floor unit the size of a large copier and is designed for up to 50 users. Xerox positions the desktop-size, 600-dpi 4520mp as a workgroup printer for 15 to 25 users: Its rated duty cycle is half that of the 4220. Both feature 20-page-per-minute print-engine speeds, simultaneously active serial and bidirectional parallel ports, optional AppleTalk and Token-Ring adapters, B-size output, true Adobe PostScript Level 2 and PCL 5; and an optional internal hard disk. Ethernet is standard on the 4520mp and optional on the 4220.

The 4220's base configuration lists for \$8,995 with 8MB RAM and is available from authorized dealers. We tested one with 20MB of RAM and an optional 60MB hard disk (\$545). Since our review, Xerox increased the hard disk to 210MB for the same price. Xerox provides a technician to set up the unit and recommends having one service the unit every 100,000 pages.



Xerox 4520mp

The 4220's score of 2 minutes 11 seconds on our Network Speed test was the best of the batch. Performance on our Text and Graphics Speed tests was average for a 20-ppm printer: 15.5 text ppm in PCL; 16 ppm in PostScript on our Text Speed test and 1.5 graphics ppm in PostScript on our Graphics Speed test. Print quality was good for a 300-dpi printer.

The 4520mp has Adobe PostScript Level 2, an Ethernet interface, and 8MB of RAM and lists for \$5,199 (\$4,100 street). Identical to the 4520mp except that the network card and PostScript are options, the Xerox 4520 comes with 4MB of RAM—expandable to 25MB—and lists for \$3,749 (\$3,100 street). Depending on the amount of RAM installed, both provide from 300 to 800 dpi. The 4520mp and 4520 come with Xerox's Document Services for Printing (see the sidebar "Fewer Walks down the Hall").

Output was dark and crisp at 600 dpi with TrueRes enhancement, but PCL 5 graphics showed banding; dark areas on some halftones appeared to lack gray scaling. Performance

was above average, with 17 text ppm in PCL, 16.3 ppm in PostScript on our Text Speed test and 1.7 graphics ppm in PostScript on our Graphics Speed test. Performance on our Windows-based graphics test was also above average. The unit's score on our Network Speed test was an average 6 minutes 32 seconds. □

► **Xerox 4520mp.** List price: \$5,199; 4MB RAM upgrade, \$299; 16MB RAM upgrade, \$1,099; 125MB hard disk, \$699; 1,500-page sheet feeder, \$649; 250 envelope feeder, \$599; Adobe PostScript Level 2, \$799; LocalTalk interface, \$185; Ethernet interface, \$499; Token-Ring interface, \$699. **Xerox 4220.** List price: \$8,995; 8MB RAM upgrade, \$595; 16MB RAM upgrade, \$1,095; 1MB flash memory upgrade, \$255; 2MB flash memory upgrade, \$420; 210MB hard disk, \$545; 1,800-page stacker, \$995; 1,500-page feeder, \$695; AppleTalk interface, \$225; Ethernet interface, \$625; Token-Ring interface, \$795; fax card, \$395. Xerox Corp., Office Document Systems Division, 80 Linden Oaks, Rochester, NY 14625; 800-275-9376.

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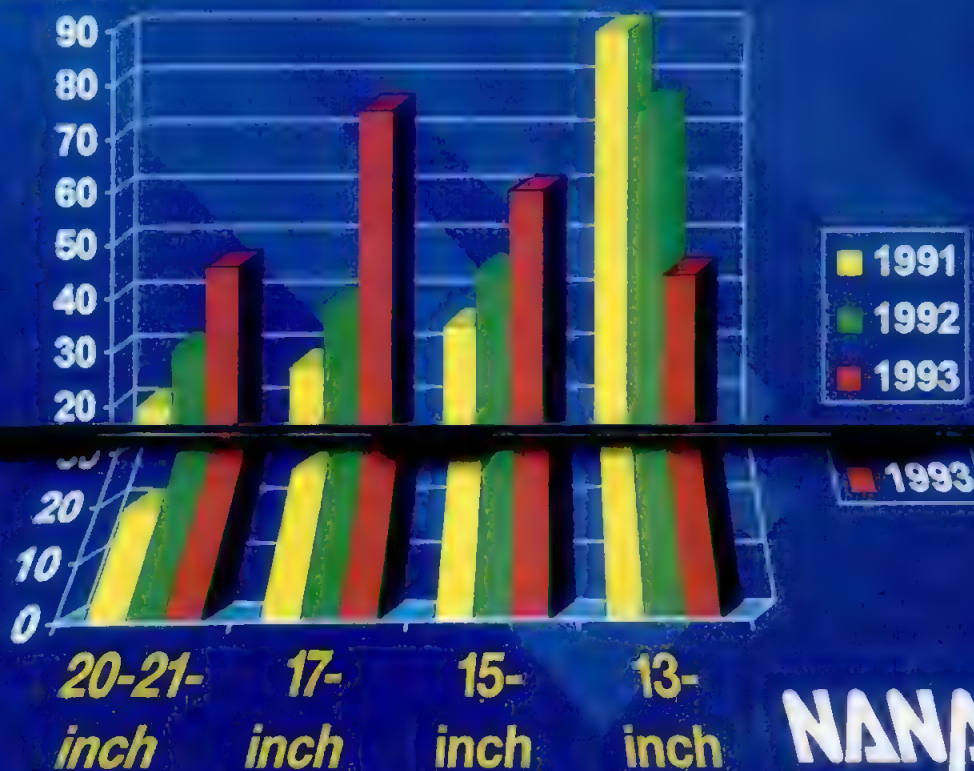
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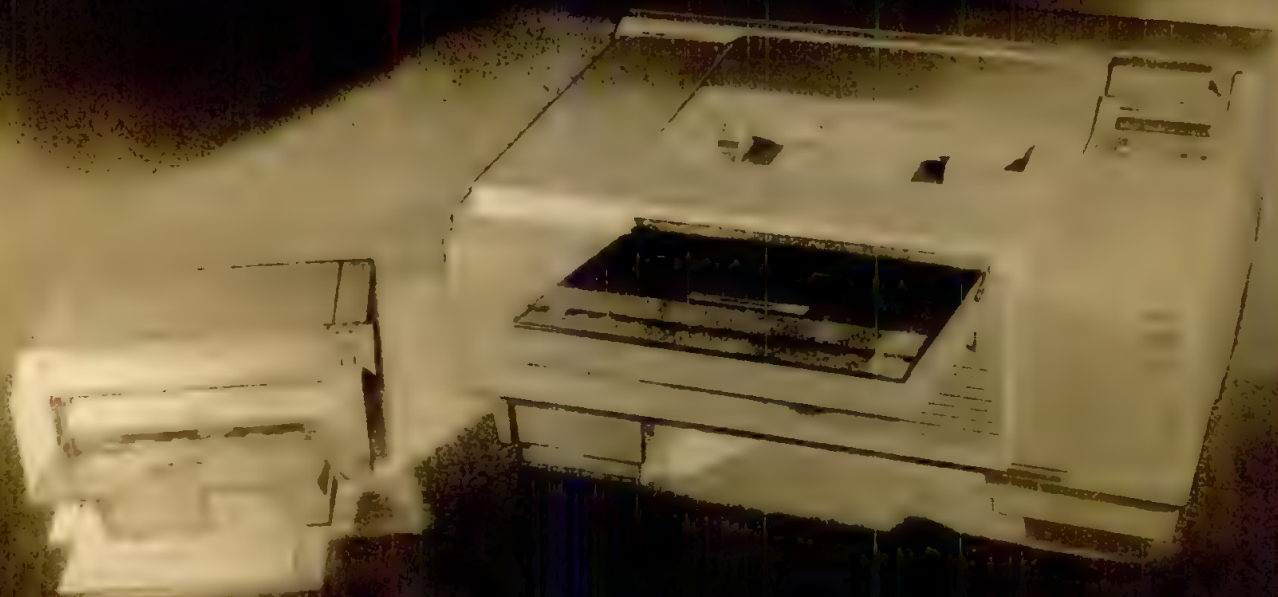
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CIRCLE 283 ON READER SERVICE CARD

High-End Color



The Best and The Brightest

If you want truly exceptional images, look to a dedicated color printer. We review 11 thermal dye, thermal wax, and solid ink units.

The distinctions are blurring. Time was, if you needed four-color output you just swallowed hard, ponied up \$15,000 or more for a dedicated color printer, and then got really stingy with the network rights to access it. No more. Ink jet and color laser technologies are coming of age, and output quality from some now rivals or even sur-

passes images produced by more traditional dedicated color units.

Blame it on Hewlett-Packard. Its DeskJet 1200C (and PostScript-enabled 1200C/PS) was the first ink jet printer—indeed, the first desktop printer of any kind—to offer reasonable speed for text and monochrome graphics plus color output that was better than some dedicated color printers could manage. Epson America has followed suit this year with the Epson Stylus Color ink jet, which in its graphics-only mode can produce

By M. David Stone

HIGHLIGHTS

High-End Color Printers

THERE'S MORE to choose from for buyers in the market for a high-end color printer. Color ink jet and color laser printers let you mix monochrome and color text and graphics on the same page. While their output doesn't outclass that of traditional thermal dye, thermal wax, and solid ink printers, color lasers and ink jets still offer a viable alternative. Users who could use the convenience of mixed color and monochrome output have some deciding to do.

PHOTO-REALISTIC IMAGES are still the province of the most expensive printer technology, thermal dye transfer. These printers produce continuous-tone images that mimic original photographs, with true flesh tones and

fine contrast. These printers also tend to be the slowest, however, and paper cost can be as high as \$3.00 per sheet, since they require special stock.

MORE AFFORDABLE COLOR images can be had from thermal wax transfer units. Colors are brilliant and well saturated, and images approach (but don't quite reach) photo-realistic standards. For graphics and prepress applications, the quality tradeoff might be worth the gains in speed and cost. The machines cost thousands less than thermal dye units, and cost per page is typically a reasonable 50 cents. All but one of the five units we looked at provides 600- by 300-dpi resolution, whereas a year ago 300-by-300 was the norm.

SOLID INK PRINTERS can print on any media that can make it through the printer. Images are similar to those produced by thermal wax units, with perhaps more dithering.

LOOK OVER YOUR SHOULDER, solid ink, because ink jets and color lasers are on your heels! The solid ink printers we review here offer super B-size output (full bleed on B-size paper); but for standard-size printing, one of the ink jets or color lasers might be a better choice.

TWO INTERESTING entries are the Fargo PrimeraPro and the Seiko Professional ColorPoint. These units offer both thermal dye and thermal wax printing, so you can pick the mode.

720-dpi images that approach photographic quality. (These printers are reviewed fully in the Ink Jet section of this issue.) The color laser printers have also come on strong in the past year. Image and color quality have improved, though prices remain high (HP's Color LaserJet is the least expensive at \$7,295). Look for our take on the Color LaserJet, QMS magicolor, and Xerox 4900 Color Laser Printer in the Personal/Workgroup Laser Printers section of this issue.

Does all this mean high-end color printers are obsolete? Not at all. Generally, we found that business users who need color graphics for reports and presentations can opt for an ink jet or color laser printer and get excellent monochrome output as a bonus. But color laser printers are somewhat cumbersome to set up and keep going, because of four sets of toner and either two sets of developer (one black, one three-color in the case of the HP Color LaserJet) or four (one for each color in the case of the QMS magicolor and Xerox 4900 Color). And some of the ink jet printers produce poor transparencies, with insufficiently saturated color. The best argument for both technologies is that they'll let you print in color on standard copier paper and on a single page of

an otherwise monochrome document, so you won't have to collate pages. You can no longer dismiss these technologies as irrelevant for high quality color, but if you're truly serious about color, your preferred color printer is more likely to be one of the eleven reviewed here.

REVIEW CRITERIA

In this section, we review dedicated color printers that employ one (and in some cases two) of three different technologies:

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thermal dye transfer, thermal wax transfer, and solid ink. To make it into this section, a printer had to be intended primarily for color, support PostScript or PCL 5C or come with a driver that works with all Windows programs, and be shipping in quantity by August 1, 1994.

Several vendors had new models in the works that were not available by our review deadline. Kodak will be shipping the Kodak XLS 8600 (\$8,995) and its PostScript Level 2 twin, the Kodak XLS 8600 PS (\$9,995). These thermal dye transfer printers can print an 8.5- by 12-inch image full-bleed on 9.5- by 14-inch media. General Parametrics Corp. will offer the Spectra*Star DSx (\$7,995), a 600- by 300-dpi, A-size thermal dye transfer printer. New-Gen Systems Corp.'s Chromax Color Printer (\$10,995), a super B-size, 300-by-300 thermal dye transfer printer, also missed our review. Seiko will offer its Professional ColorPoint2 PSF model 4 (\$8,999), a letter- and legal-size-only version of the model 14 we review here.

We received four thermal dye transfer, two solid ink, and three thermal wax printers, and two units—the Fargo PrimeraPro Color Printer and Seiko Professional ColorPoint2 PSF model 14—that use both thermal dye and thermal wax technolo-

gies. The dual technologies serve different purposes in each printer. As a personal printer, the PrimeraPro lets you print whichever kind of output is most appropriate to the task at hand. The presumption for the ColorPoint2 (aimed at graphic artists) is that you'll want final output in thermal dye transfer mode. But by using thermal wax for proofs, you can save several dollars for each, which can quickly add up in a graphics shop that prints hundreds of images each week.

We ran all the printers in this section through *PC Magazine's* tests for graphics speed and printer compatibility. In addition, we printed a sample 24-bit color photo from Photoshop, and a business graphic from Harvard Graphics for Windows, using appropriate paper stock in each case. The Color Output Samples show actual printouts.

One significant difference among the technologies is speed. In general, we found the thermal wax transfer printers to be a touch faster than solid ink printers, but significantly faster than the thermal dye transfer units. The two thermal wax transfer Tektronix Phaser 220s and the DECcolorwriter 1000 (which employs the same Tektronix engine) produced 0.7 graphics pages per minute (gppm) on our Graphics Speed test. By comparison, the quickest thermal dye transfer entries—the Tektronix Phaser 440 and 480—managed only 0.3 gppm. The solid ink Brother HS-1PS Level 2 Color and Tektronix Phaser 300i produced 0.5 and 0.6 gppm. The dual-technology Seiko ColorPoint2 did not gain a speed advantage in thermal wax transfer mode, producing 0.3 gppm under both modes, and the slowest printer of the lot was the thermal dye transfer Mitsubishi Shinko ColorStream DS/Plus CHC-S746i at a painfully slow 0.1 gppm.

THERMAL DYE TRANSFER

If you think about how thermal dye transfer printers produce their output, you'll understand why speed is not a strong point: Such units heat a ribbon containing dye and diffuse the dyes onto specially coated paper or transparencies. It's a complex process, but the results are worthy: Thermal dye transfer printers are still the only choice for continuous-tone, photographic-quality output. In this roundup,



Low-cost:

- **Fargo PrimeraPro Color Printer**

Medium and high-cost:

- **DECcolorwriter 1000**
- **Tektronix Phaser series**

Picking 7 Editors' Choices out of a field of 11 may seem a bit extreme, but it's a testament to the caliber of the high-end color machines on the market today.

It's also a testament to the machines from Tektronix, in particular. All five offerings from the company's Phaser line define the state of the art in their respective categories.

For photo-realistic images, the only acceptable choice is still thermal dye transfer technology. Of the six such units we reviewed, Tektronix's super A-size Phaser 440 (\$7,995) and the full-bleed super B-size Phaser 480 (\$14,995) are without equal. Image quality was the best we've seen from this technology, with flawless reproduction of our test photo and brilliant color on our sample business graphic. The Kodak ColorEase PS Printer, a thermal dye Editors' Choice winner last year, still offers excellent color, but the Tektronix units reproduced our test photo more precisely.

Meanwhile, the Tektronix Phaser 220e (\$3,650 street) and its sibling, the Phaser 220i (\$5,279 street), produced the best color graphics we've seen from thermal wax printers. Digital's DECcolorwriter 1000 (\$3,600 street) garners an Editors' Choice as well, since it is a closely allied unit based on the same Tektronix/Sharp engine. All these PostScript-equipped printers offer 600- by 300-dpi resolution plus enhancement tricks that smooth text and minimize color dithering. The result is near-photo-realistic images.

For (relatively) affordable high-end super B-size printing, the Phaser 300i (\$8,258 street) is a solid ink printer that can print brilliant 300- by 300-dpi color output on any paper that will make it through the printer. Its image quality rivals output from

the best thermal wax printers.

In a category all its own is our final Editors' Choice, the Fargo PrimeraPro Color Printer. If you need high-end color output but can't spend many thousands of dollars, look here. For a street price of just under \$1,600, you get a printer that offers *both* thermal dye transfer and thermal wax transfer output, so you can pick which is best for a particular print job.

Why so cheap? A GDI printer that uses your computer's CPU to rasterize images, the PrimeraPro can do so without having its own RISC processors, printer languages, and RAM. The tradeoff is that the printer is slow (a minute and a half for a thermal wax page, 10 minutes or more for thermal dye) and that it also makes no pretenses toward being networkable. Images from the 600- by 300-dpi printer rival those from its more expensive counterparts. In thermal dye mode, continuous-tone shading and flesh tones were excellent, and thermal wax images were just a bit behind the Editors' Choice leaders. Fargo should be offering a PostScript interpreter (\$399.95) by the time this issue appears.

Most importantly, though, you won't be disappointed with the output quality of any of the 11 reviewed printers. Interested readers should also flip to the section on ink jet printers, where the Hewlett-Packard DeskJet 1200C and 1200C/PS are discussed. These Editors' Choice winners produce output rivaling thermal wax transfer units at a very affordable price.

Benchmark Tests: High-End Color Printers

Print speed is closely linked to technology: Thermal wax printers were the fastest, followed by solid ink and thermal dye.

What the Numbers Mean

Three thermal wax transfer printers tied for first on the Graphics Speed test: the DECcolorwriter 1000, the Tektronix Phaser 220e, and the Tektronix Phaser 220i, all producing 0.7 graphics pages per minute (gppm). Each uses a three-color ribbon, but the DECcolorwriter required four passes to produce an image, instead of the expected three. The Tektronix Phaser 300i, a solid wax printer, was close behind at 0.6 gppm. The slowest printer in this batch (0.1 gppm) was the thermal dye Mitsubishi Shinko ColorStream DS/Plus CHC-S746i.

Three of the printers we looked at—the Brother HS-1PS, DECcolorwriter 1000, and Tektronix Phaser 220e—claimed Energy Star compliance, but our Power Consumption test revealed that all three consume more than the allowable 30

POWER CONSUMPTION

	Power consumption at rest (watts)	Power consumption when printing (watts)	Power consumption in power-saver mode (watts)
Brother HS-1PS Level 2 Color	149	206	34
DECcolorwriter 1000	41	67	40
Easman Kodak ColorEase PS Printer	58	104	N/A ¹
Fargo PrimeraPro Color Printer (thermal dye mode)	N/A ²	N/A ²	N/A ²
Fargo PrimeraPro Color Printer (thermal wax mode)	N/A ²	N/A ²	N/A ²
Mitsubishi Shinko ColorStream DS/Plus CHC-S746i	77	123	N/A ¹
Seiko Professional ColorPoint2 PSF model 14 (thermal dye mode)	46	93	N/A ¹
Seiko Professional ColorPoint2 PSF model 14 (thermal wax mode)	47	92	N/A ¹
Tektronix Phaser 220e	38	77	37
Tektronix Phaser 220i	46	67	N/A ¹
Tektronix Phaser 300i	108	224	N/A ¹
Tektronix Phaser 440	58	97	N/A ¹
Tektronix Phaser 480	55	124	N/A ¹

N/A¹—Not applicable. The printer does not have a power-saver mode.

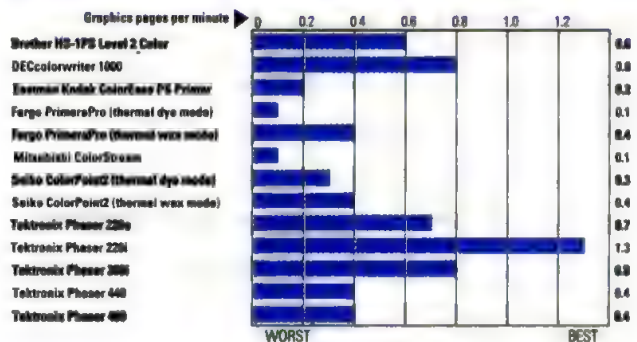
N/A²—Not applicable. The printer's power cable is not compatible with our Dranetz test device.

GRAPHICS SPEED

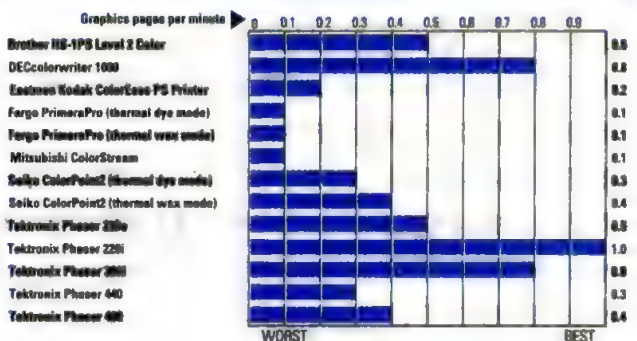
	Graphics pages per minute
Brother HS-1PS Level 2 Color	0.7
DECcolorwriter 1000	0.7
Easman Kodak ColorEase PS Printer	0.2
Fargo PrimeraPro (thermal dye mode)	N/A
Fargo PrimeraPro (thermal wax mode)	N/A
Mitsubishi ColorStream	0.1
Seiko ColorPoint2 (thermal dye mode)	0.3
Seiko ColorPoint2 (thermal wax mode)	0.3
Tektronix Phaser 220e	0.7
Tektronix Phaser 220i	0.7
Tektronix Phaser 300i	0.6
Tektronix Phaser 440	0.3
Tektronix Phaser 480	0.3

N/A—Not applicable. The PrimeraPro Color Printer is a GDI printer and could not perform our DOS-based test.

LOTUS 1-2-3 FOR WINDOWS



CORELDRAW



watts while in sleep mode. Consuming 37 watts, the HS-1PS came the closest.

On the Lotus 1-2-3 test, the Phaser 220i again topped the others, running through our test image at 1.3 gppm—a phenomenal speed for a high-end color printer and on a par with many 6- and 8-ppm laser printers. The Phaser 220i was also best on the CorelDRAW test, producing 1.0 gppm. At the bottom of the heap on both tests were the Fargo PrimeraPro Color Printer (in thermal dye mode) and the Shinko ColorStream, both at 0.1 gppm.

How We Tested

The **Graphics Speed** test measures the printer's speed in producing two copies of a complex single-page graphic containing a TIFF image, horizontal and vertical gray scales, horizontal color scales, and line art. A print file is sent directly to the printer from DOS.

The **Power Consumption** test measures the printer's energy usage under three conditions: when printing, when idle, and when in power-saving mode (where available).

The **Lotus 1-2-3 for Windows** test measures the printer's speed in producing a complex two-page spreadsheet that contains color pie, bar, and line charts. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

The **CorelDRAW** test measures the printer's speed in producing a single-page CorelDRAW graphic that contains a TIFF image, horizontal and vertical gray scales, and line art. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

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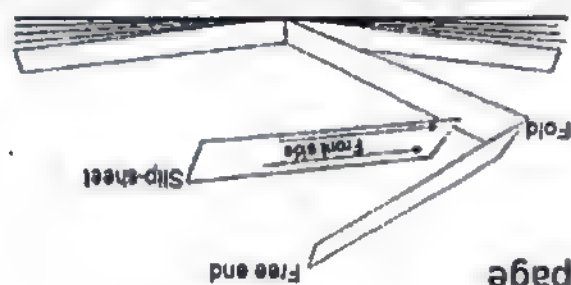
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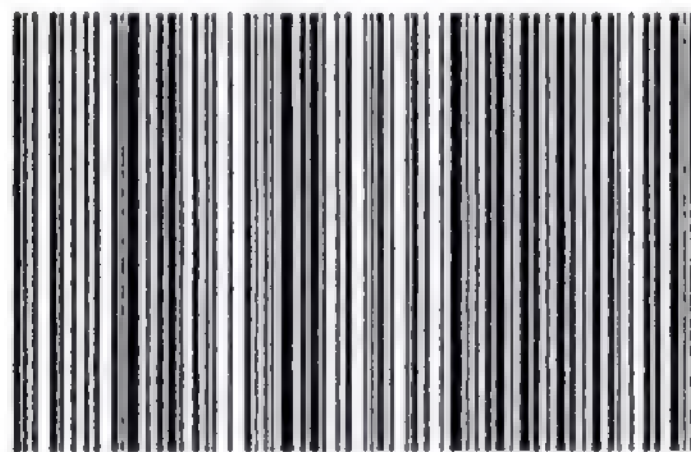
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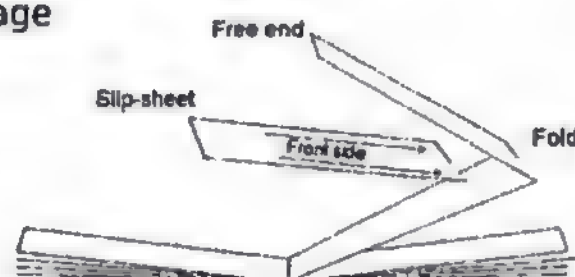


GbsSlipSheet-001

Folded edge of the page

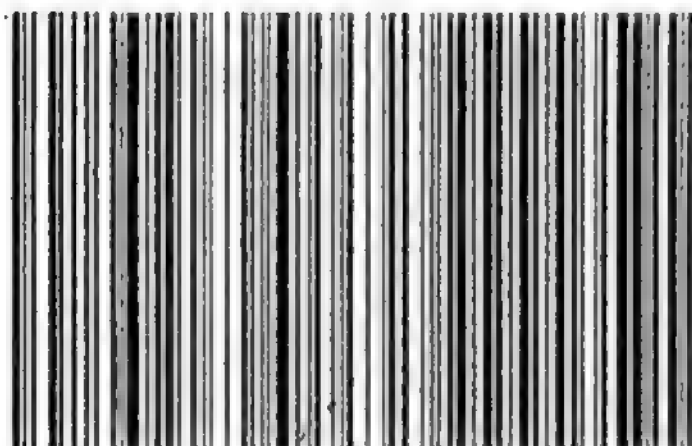
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



GbsSlpBack-001B

Back

1. Follow instructions on the other side

#1 in the independent VeriTest Steeplechase Battery test.[†]
In fact, the Dell® Latitude™ XP DX2/50 destroyed the previous 486 battery life record by almost 5 hours.

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(Testing with power management. Actual battery life will vary depending on nature and frequency of use and configuration.)

NEW RECORDS:	hrs:mins
Dell Latitude XP DX2/50 STN	17:05
Dell Latitude XP DX4/75 STN	16:01
Dell Latitude XP DX4/100 TFT	14:48
Dell Latitude, 2 NiMH batteries DX2/50 STN	12:15
OLD RECORD FOR 486 MONO:	12:07
IBM ThinkPad 350C (SL/25) passive	8:50
IBM ThinkPad 500 (486/slc) mono	6:30
Toshiba T4800cr (DX4/75) TFT	5:30
IBM ThinkPad 755Cs (DX4/75) passive	5:00
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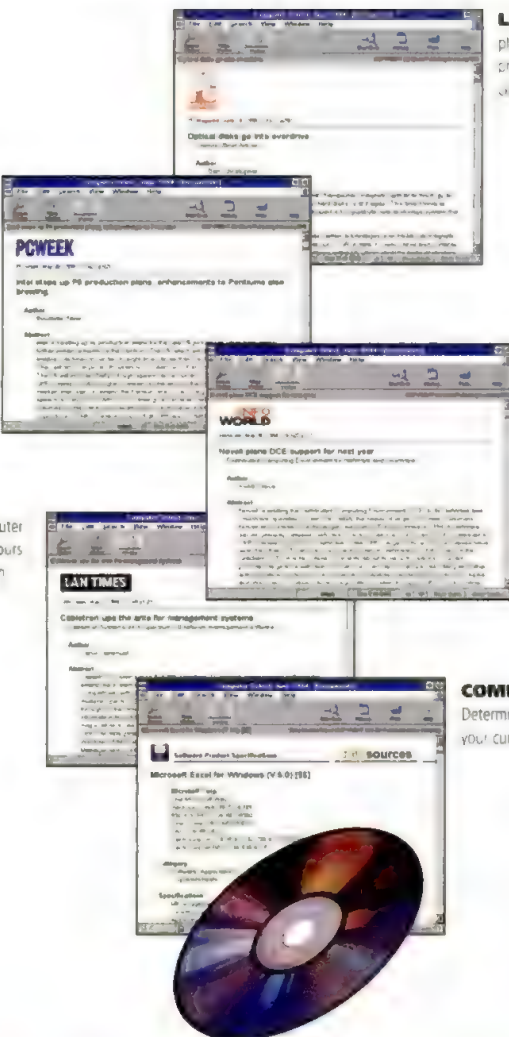
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CIRCLE 158 ON READER SERVICE CARD

Eastman Kodak's ColorEase, Fargo's PrimeraPro, Mitsubishi's ColorStream, Seiko's ColorPoint2, and the Tektronix Phaser 440 and 480 use this technology.

The maximum resolution for all but one of these printers is 300 by 300 dpi. That's actually equivalent to higher resolutions with other technologies because these printers don't use dithering dot patterns to show gray scales and color. Instead, they overlay translucent dyes to produce photorealistic output and vibrant, dither-free colors for graphics. The range from best- to worst-looking output is relatively small, so note that the inexpensive (less than \$1,600 street price) PrimeraPro offers some of the best-looking output in this group for significantly less than the others.

The drawbacks to this technology remain the heavy, photographic-like paper, and a high per-page cost. Since last year, prices for consumables have stayed constant or fallen a few cents for any given printer. But this year's printers typically use more expensive paper than last year's, which, along with improved algorithms, is partly responsible for the better-looking output this year. Per-page cost for most A-size printers is \$2.00 to \$2.80 for paper and \$2.50 to \$3.50 for transparencies.

The big news this year is the availability of three super B-size printers: the Phaser 480, Seiko's ColorPoint2, and Mitsubishi's ColorStream. These printers can produce full-bleed images on media of up to 11 inches by 25 inches in size. The street prices of \$12,700 to \$15,000 are higher than for the thermal dye transfer printers we looked at last year, but none of those printers offered B-size printing, much less full-bleed B size.

THERMAL WAX TRANSFER

The quicker thermal wax transfer printers work by heating wax-based inks that adhere to paper or transparencies. Five printers in this roundup use this method: the DECcolorwriter 1000, Fargo's PrimeraPro, Seiko's ColorPoint2, and Tektronix's Phaser 220e and 220i.

All but one of the printers (the ColorPoint) offer 600- by 300-dpi resolution, an improvement over last year's 300-by-300 fare. Three printers—the DECcolorwriter 1000, the Tektronix Phaser 220e and 220i—also offer image-enhancement

techniques to minimize dithering and posterization. The result is a new norm for thermal wax output: nearly dither-free graphics and something approaching but not quite reaching continuous-tone output for photos.

Street prices for these A-size printers—\$3,600 to \$5,279—is about the same as for last year's 300- by 300-dpi printers (the exception, again, is the \$1,600 PrimeraPro). The prices of consumables are essentially unchanged since last year for a given paper size. Typical per-page cost for most A-size printers is still between 50 and 60 cents per page for paper and \$1.40 to \$1.60 per transparency.

SOLID INK

There's no generally accepted name for printers that melt wax and then spray it on paper, but here we'll call them solid ink or wax jet printers. These include the Brother HS-1PS and Tektronix Phaser 300i; they are known for printing in brilliant color on any paper that can make it through the printer's paper feed. The weakness for this technology remains the lensing effect of the dried wax drops on transparencies, even with extra processing steps to flatten the drops.

Images from the better of the two units, the Phaser 300i, are in competition with those from the best thermal wax transfer printers. Dithering is more obvious because the Phaser 300i offers only 300-dpi resolution, but colors are more vibrant. Both the Brother and Tektronix printers handle up to super B-size paper.

Consumable prices are difficult to calculate, in large part because there is no standard image on which to base the calculations. But BIS Strategic Decisions, a market-research firm based in Norwell, Massachusetts, calculates 90 cents to \$1.25 per page for 100 percent coverage of a full-size image on letter-size paper using equal amounts of cyan, magenta, yellow, black, red, green, and blue.

So will you get a high-end color printer or opt for the convenience of the ink jets and color lasers? If you need color simply

for business graphics, the better choice is probably the latter. But if only near-flawless images will do, the balance tips in favor of the high-end printers reviewed here.

Brother International Corp.

● Brother HS-1PS Level 2 Color Printer

ALL REVIEWS BY
M. DAVID STONE

Solid-ink printers have been few and far between in *PC Magazine's* yearly printer issues, which makes the Brother HS-1PS Level 2 Color Printer and the Tektronix Phaser 300i in this year's roundup relative rarities. With a list price of \$8,995 (\$7,500 to \$8,000 street), the top-of-the-line HS-1PS is meant for workgroups or special applications that need to print brilliant color output on standard stock up to super B-size.



Brother HS-1PS Level 2 Color

The printer is built around Brother's own engine and controller. Maximum resolution is 300 by 300 dots per inch; the printer offers no resolution enhancement. The HS-1PS is PostScript Level 2-compatible, using Brother's

own Level 2 clone, BR-Script. The printer also offers PCL 5C, the only color PCL emulation in any of the printers in this section.

Maximum image area ranges from a substantial 8.2 by 10.3 inches on letter-size paper to 11.8 by 19.3 on super B-size; 200-sheet paper cassettes for each come standard. The unit can also handle transparencies. Output quality is arguably a notch above the best thermal wax transfer output, with fully saturated, more brilliant color without the glossy sheen. The "arguable" part: The 300- by 300-dpi resolution, without any enhancement, leaves visible dithering patterns. These detract from the overall effect compared with thermal wax printers with higher resolution. Cost per page is a reported \$1.67 for 50 percent coverage, reasonable for a high-end unit.

The printer sailed through our Graph-

Brother HS-1 PS Level 2 Color

\$8,995

Super B-size solid-ink printer (Brother HS-1 engine) with 25-MHz IDT R3051 processor, PostScript Level 2 clone, PCL 5C

Graphics Speed: 0.5 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

0.6 gppm

CorelDRAW: 0.5 gppm



Shinko ColorStream DS/Plus CHC-S746i

\$15,500

Super B-size thermal dye transfer printer (Shinko CHC-S745 engine) with 25-MHz AMD Am29050 processor, PostScript Level 2 clone

Graphics Speed: 0.1 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

0.1 gppm

CorelDRAW: 0.1 gppm



DECcolorwriter 1000

\$3,999

Super A-size thermal wax transfer printer (Tektronix/Sharp model 4681 engine) with 16-MHz AMD Am29000 processor, Adobe PostScript Level 2

Graphics Speed: 0.7 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

0.8 gppm

CorelDRAW: 0.8 gppm



Seiko Professional ColorPoint2 PSF model 14

\$10,499

Super B-size thermal wax/thermal dye transfer printer (Seiko proprietary engine) with 33-MHz Intel 80960 CF Superscalar processor, Adobe PostScript Level 2

Graphics Speed: 0.3 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

0.3 gppm (thermal dye mode),

0.4 gppm (thermal wax mode)

CorelDRAW: 0.3 gppm (thermal

dye mode), 0.4 gppm (thermal

wax mode)



Eastman Kodak ColorEase PS Printer

\$6,495

Letter-size thermal dye transfer printer (Eastman Kodak proprietary engine) with 40-MHz Sun SPARC processor, Adobe PostScript Level 2

Graphics Speed: 0.2 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

0.2 gppm

CorelDRAW: 0.2 gppm



Tektronix Phaser 220e

\$3,995

Letter-size thermal wax transfer printer (Tektronix/Sharp Model 4681 engine) with 16-MHz AMD Am29000 processor, Adobe PostScript Level 2, PCL 5

Graphics Speed: 0.7 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

0.7 gppm

CorelDRAW: 0.5 gppm



Fargo PrimeraPro Color Printer

\$1,895

Super A-size thermal wax/thermal dye transfer printer (Fargo proprietary engine) with GDI and optional Adobe PostScript Level 2

Graphics Speed: N/A

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

0.2 gppm (either mode)

CorelDRAW: 0.1 gppm (thermal

dye mode), 0.4 gppm (thermal

wax mode)

N/A—This application: This unit is a GDI printer and could not run our DOS-based test.



Tektronix Phaser 220i

\$5,995

Letter-size thermal wax transfer printer (Tektronix/Sharp Model 4681 engine) with 24-MHz AMD Am29000 processor, Adobe PostScript Level 2, PCL 5

Graphics Speed: 0.7 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

1.3 gppm

CorelDRAW: 1.0 gppm



COVER STORY
High-End Color

Tektronix Phaser 300i

\$9,995

Super B-size solid ink printer (Tektronix Model 4699 engine) with 24-MHz AMD Am29000 processor, Adobe PostScript Level 2, PCL 5

Graphics Speed: 0.6 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows

0.8 gppm

CorelDRAW: 0.8 gppm



Tektronix Phaser 480

\$14,995

Super B-size thermal dye transfer printer (Tektronix/Mitsubishi Model 4688 engine) with 24-MHz AMD Am29000 processor, Adobe PostScript Level 2

Graphics Speed: 0.3 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows

0.4 gppm

CorelDRAW: 0.4 gppm



Tektronix Phaser 440

\$7,995

Legal-size thermal dye transfer printer (Tektronix/Sharp Model 4685 engine) with 24-MHz AMD Am29000 processor, Adobe PostScript Level 2

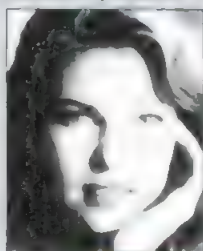
Graphics Speed: 0.3 gppm

WINDOWS APPLICATIONS:

Lotus 1-2-3 for Windows:

0.4 gppm

CorelDRAW: 0.3 gppm



ics Speed test (PostScript), turning in a score of 0.5 graphics pages per minute. Though you're much more likely to use the HS-1PS as a PostScript printer, it's important to note that the unit stumbled in PCL mode, failing to print the text portion of the Graphics Speed test.

Even with higher resolution creeping into the competing technologies, the HS-1PS is still impressive.

► **Brother HS-1PS Level 2 Color Printer** List price: \$8,995; 200-sheet letter-size paper cassette, \$100; 200-sheet legal-size or B-size paper cassette, \$150; set of ink pellets (two black, one each cyan, magenta, yellow), \$180; set of five black ink pellets, \$160. Brother International Corp., 200 Cottontail Ln., Somerset, NJ 08875; 800-276-7746, 908-356-8880; fax, 908-469-4415.

Circle 453 on reader service card

Digital Equipment Corp.

EDITORS' CHOICE
DECcolorwriter 1000

It's too bad that Digital already used *Rainbow* as the name for its early desktop computers because it would be an

The DECcolorwriter uses the same Tektronix/Sharp engine as the Tektronix Phaser 220e (also reviewed in this section) and comes with the same Tektronix Windows driver and utilities for controlling the printer from DOS.

The key differences, according to Digital, are some changes in firmware to pro-



vide greater feedback to workstations over a network, and some additional connection options—including, for example, support for DECnet over an Ethernet connection.

As with the Phaser 220e, you have a choice of ribbons for printing on coated stock or standard copier paper. Maximum image size is 8.1 by 10 inches on A-size

paper and transparencies, or 8.1 by 10.6 inches on slightly longer stock with a perforated edge. Cost per page of 54 cents is not only low for high-end color, it's also much lower than that of other thermal wax units.

Most importantly, the DECcolorwriter is tied with the Tektronix Phaser 220e and Phaser 220i for the best-looking color output that PC Labs has seen yet for this technology. Brilliant, saturated colors combine with the maximum 300- by 600-dot-per-inch resolution to yield nearly unbeatable graphics output. And thanks to Tektronix's resolution enhancement, which minimizes dithering patterns and posterization, the DECcolorwriter approaches photorealistic output for scanned photos. Speed on our tests was also respectable for the technology: 0.7

graphics pages per minute, which adds even more luster to an already attractive package.

► **DECcolorwriter 1000.** List price: \$3,999; 22 additional Adobe Type 1 fonts, \$595; 100-sheet paper cassettes (A-, perforated A-, A4-, or perforated A4-size), \$99 each; second 100-sheet cassette and feeder, \$495; external thinwire Ethernet adapter, \$379. Digital Equipment Corp., 146 Main St., Maynard, MA 02174; 800-777-4343, 508-493-5111; fax, 800-234-2298.

Circle 454 on reader service card

Eastman Kodak Co.

• **Kodak ColorEase PS Printer**

As an Editors' Choice winner in last year's printer blockbuster, the thermal dye transfer Kodak ColorEase PS Printer is a target for others to beat. Bracketed by the far less expensive but far slow-

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Color Output Samples

All of the thermal dye transfer output (shown on this and the next page) offers photorealistic continuous-tone images without any hint of dithering. The difference between the best and worst printers is minimal. Some of the printers, however, lose a sig-

Thermal Dye Transfer



Eastman Kodak ColorEase

\$6,495



Fargo PrimeraPro Color Printer

\$1,895



Mitsubishi Shinko ColorStream

\$15,500

er Fargo PrimeraPro and Tektronix's more expensive Phaser 440, the \$6,495 ColorEase is largely unchanged since last year and offers photorealistic output at a relatively low price. But the competition is stiffer this year, and the ColorEase no longer stands out so much.

The key difference from the version we tested last year is a \$299 option that allows printing on 8.5- by 12-inch stock for a maximum 8- by 10-inch image. There are also some changes in the firmware that provide a smoother color gradient for continuous-tone images, according to Kodak, along with other changes for improving compatibility with NetWare. Resolution is still 300-by-300 dpi, and the printer offers Adobe PostScript Level 2. It managed a

slow 0.2 graphics pages per minute on all our speed tests.

Output quality is excellent, with saturated, brilliant colors for graphics, photorealistic shading for continuous-tone images, and realistic skin tones for color



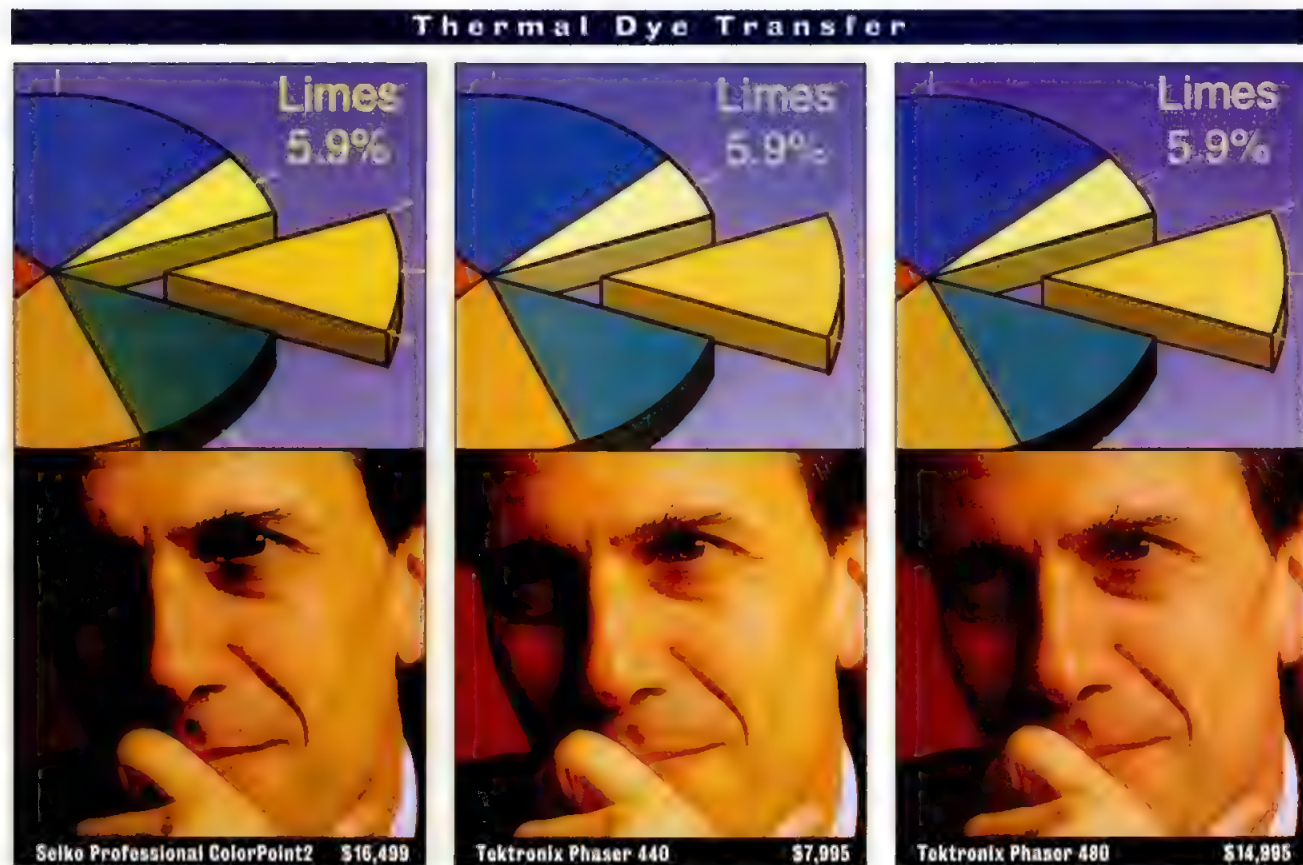
Kodak ColorEase PS Printer

images. We noticed, however, that the color test photo lost a great deal of detail in shadowed areas compared with the results for most other thermal dye transfer printers. Per-page cost is less than for its direct competitors, coming in at around \$2.00 for each paper printout and \$2.50 for transparencies.

Alas, the ColorEase can no longer claim higher quality output at a lower price than most of the competition. But the printer's output quality looks fine unless you compare it with that of more expensive offerings, so the ColorEase is still a reasonable choice.

► **Kodak ColorEase PS Printer.** List price: \$6,495; 100-sheet A4-size cassette, \$175; additional 100-sheet letter-size cas-

nificant amount of detail on the shadowed side of the face. The Tektronix Phaser 440 output retains the most detail and is essentially identical to the original photo. All of these printers offer vibrant, dither-free colors for business graphics, well-formed text, and sharp edges for text, lines, and graphical shapes.



sette, \$140; 8- by 10-inch image kit (includes 100-sheet 8.5- by 12-inch cassette), \$299; three-color ribbon, \$145; EtherTalk, \$495. Eastman Kodak Co., 901 Elmgrove Rd., Rochester, NY 14650; 800-344-0006, 716-724-4000; fax, 716-724-2899.

Circle 491 on reader service card

Fargo Electronics Inc.



EDITORS' CHOICE
Fargo PrimeraPro
Color Printer

Do you ever wish you could have the high quality color output of a thermal wax or thermal dye transfer printer, but you can't justify the price? The Fargo PrimeraPro Color Printer may be your answer. The 600- by 300-dpi PrimeraPro offers both technologies at a list price of \$1,895

(\$1,600 street).

The PrimeraPro depends on the attached computer to rasterize the printed image; thus the printer itself can do without such expensive niceties as a RISC processor or large amounts of RAM. It also does without any built-in languages. For those who must have PostScript, Fargo's Adobe PostScript software interpreter (\$399.95) should be available soon after you read this. However, the printer's graphics device interface (GDI) driver will let you print from any Windows program. An Amiga driver is also available, as is a Mac-



intosh version of the printer.

Be aware that the PrimeraPro is slow. The claimed maximum engine speeds—1.5 minutes per page for thermal wax and a go-get-some-coffee speed of 9 to 12 minutes per page

for thermal dye—will give you some idea of how slow, although the actual speed will depend on your computer.

The good news is that the output is worth waiting for. Output quality for thermal dye transfer mode was consistently among the best for all our test images, with bright, fully saturated colors for



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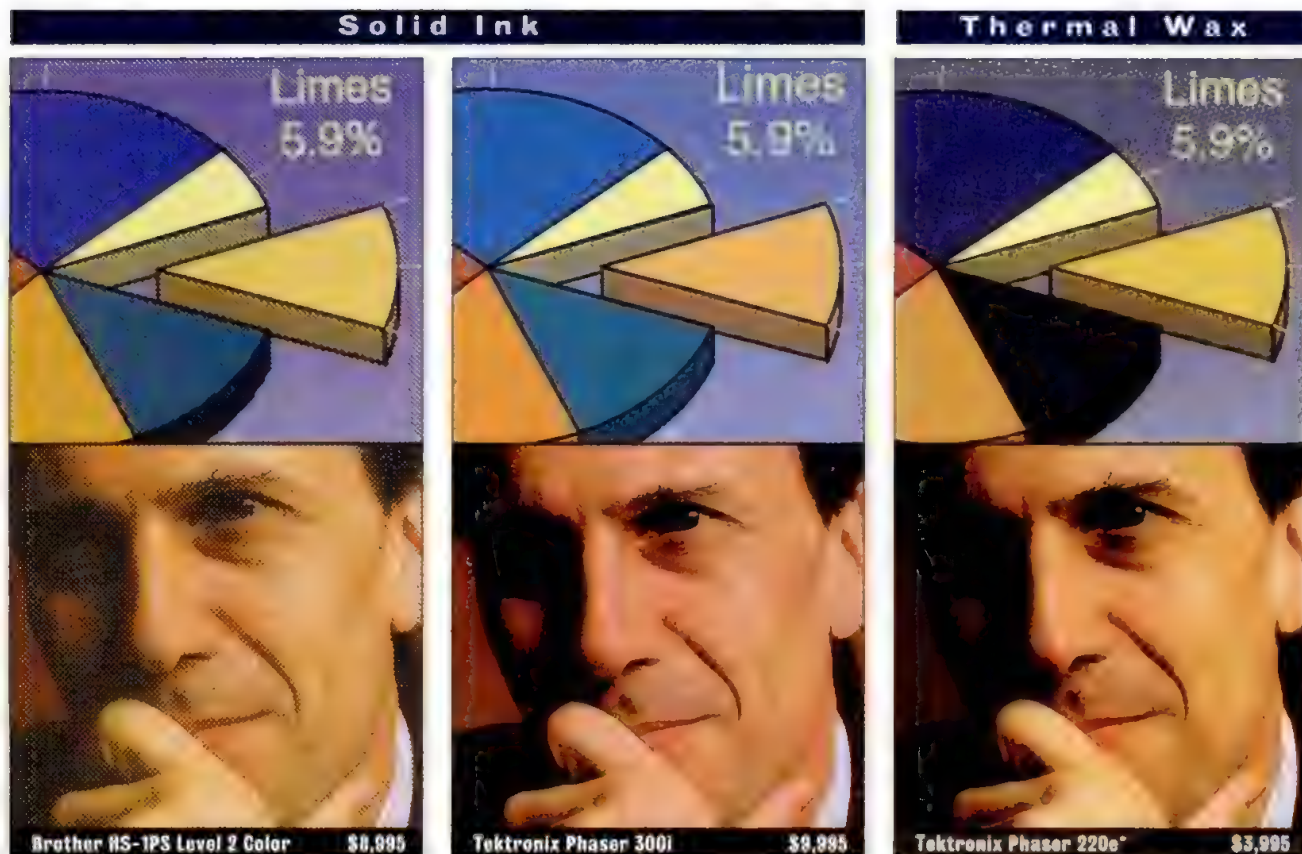
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■ Color Output Samples, continued

Output from solid ink and thermal wax printers is crisp and vibrant. Resolution enhancements all but eliminate visible dithering patterns for the 300- by 300-dpi Tektronix Phaser 300i output and the 300- by 600-dpi Tektronix Phaser 220i output.



* Output was virtually identical to that of the Phaser 220i and DECcolorwriter

graphics, continuous-tone shading for photos, and impressively good flesh tones. In thermal wax transfer mode, the printer's image quality was nearly as good as that of the DECcolorwriter 1000 and Tektronix Phaser 220e and 220i. Per-page cost in thermal dye mode is slightly above average (\$2.79), but very reasonable in thermal wax mode (\$1.36).

While the PrimeraPro boasts a 600- by 300-dpi mode, the gain in output quality compared with that of 300- by 300-dpi resolution is often not worth the extra time. Even at the lower resolution, though, you'll have nothing but praise for the printer's output.

► **Fargo PrimeraPro Color Printer.** List price: \$1,895; monochrome thermal wax transfer ribbon, \$39.95; three-color or four-color thermal wax transfer ribbon,

\$45; three-color thermal dye transfer ribbon and paper, \$279.95. Fargo Electronics Inc., 7901 Flying Cloud Dr., Eden Prairie, MN 55344; 800-327-4622, 612-941-9470; fax, 612-941-7836.

Circle 492 on reader service card

Mitsubishi International Corp.

• Shinko ColorStream DS/Plus CHC-S746i

The Shinko ColorStream DS/Plus CHC-S746i (\$15,500 list price; \$12,700 to \$14,950 street price), distributed by Mitsubishi International Corp., is targeted for corporate art departments, graphic art studios, CAD users, and others who won't settle for less than a super B-size printer and full-bleed B-size images. Maximum image size is 8.2 by 8.9 inches on letter-

size paper, and up to 11.7 by 17.1 inches for super B-size.

Speed is not a strong point. The ColorStream uses a Quintar controller and a Shinko 300- by 300-dpi engine, and claimed speed for the engine is roughly 80 seconds per pass for super B size in 64-color mode or 130 seconds per pass in full-color mode. In real-world terms, this translates to "noticeably slow": less than 0.1 graphics pages per minute on our tests.

The unit we reviewed came with PowerPage Level 2, Version 2.22, a Level 2 PostScript-compatible interpreter from Pipeline Associates. On PC Labs tests, however, the printer stumbled on our PostScript Level 2 compatibility test, failing to print anything in response to the Level 2 file. According to Mitsubishi, the

problem between the Version 2.22 interpreter and some Level 2 files has been addressed, although not in time for our tests.

Output from the ColorStream is not quite up to the very best representatives of thermal dye transfer technology, but it's not far behind. Graphics output offers bright, saturated colors, while photos print with appropriate, photorealistic shading. But the per-page cost for A-size output is a high \$5.49.

Despite the slow speed and minor compatibility problem, the ColorStream can still be worth considering. If you need to do super B-size printing, there aren't many thermal dye transfer printers from which to choose, and the ColorStream is the least expensive of the batch. Its low price along with its reasonably high output quality, makes an acceptable if not terribly inspiring combination.

► **Shinko ColorStream DS/Plus CHC-**



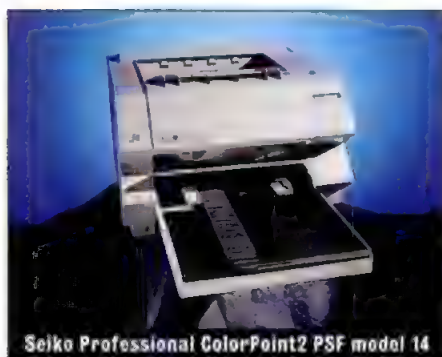
S746i. List price: \$15,500; 50-sheet letter-to super A-size paper cassette, \$650; EtherTalk, \$695; AGFA FotoTune for Windows color-management software, \$500. Mitsubishi International Corp., 701 Westchester Ave., White Plains, NY 10604; 914-997-4999; fax, 914-997-4976.

493 on reader service card

Seiko Instruments USA Inc.

► **Seiko Professional
ColorPoint2 PSF model 14**

The Seiko Professional ColorPoint2 PSF model 14, from Seiko Instruments USA, is one of three super B-size thermal dye transfer printers in this roundup. Like Mitsubishi's Shinko ColorStream DS/Plus CHC-S746i and the Tektronix Phaser 480, the ColorPoint is aimed at graphic artists and others who need full-bleed B-size images. But unlike its competitors, this



printer is also a thermal wax transfer unit, which means that the \$16,499 list price (\$14,000 to \$15,000 street price) buys two printers in one.

By offering the two technologies in one printer, Seiko can save you several dollars per image by letting you use the thermal wax transfer mode for proofs (\$1.28 per page for 11 by 17 inches) and the more expensive thermal dye transfer mode (\$8.40 per page) for final output. You can also save time this way, since the thermal wax transfer mode can be faster for small files; a given print job that will fit within RAM for thermal wax output may need to spill over to the printer's built-in hard disk for thermal dye output. In our tests, graphics throughput was about 0.3 graphics pages per minute, with a negligible difference between modes. Both modes use Adobe PostScript Level 2.

Unfortunately, output quality is not up to that of the competition. The 300- by 300-dpi thermal wax transfer output offers fully saturated color, but with obvious dithering on our tests. Seiko reports that after we finished testing, it changed the printer's default line screen to a setting that minimizes dithering patterns in most cases.

Output for thermal dye transfer mode is excellent in many ways, with saturated, brilliant colors for graphics and photorealistic shading for continuous-tone images. But the test photo loses more detail in shadowed areas than with any other thermal dye transfer printer included here. The darker areas also have a sheen that turns into a shiny, opaque black from some angles. Again, Seiko says that since our tests, it has all but eliminated this problem.

Ultimately, the output quality on our tests isn't quite what it should be. But if

Seiko has indeed solved these output problems, as claimed, the ability to print proofs in the less expensive thermal wax transfer mode makes this a cost-saving and very intriguing printer.

► **Seiko Professional ColorPoint2 PSF model 14.** List price: \$16,499; 100-sheet letter- to A4-size cassette, \$180; four 1MB SIMMs, \$395; four 4MB SIMMs, \$1,595; four 16MB SIMMs, \$5,995; EtherTalk, \$699; TCP/IP, \$699; EtherTalk and TCP/IP together, \$999. Seiko Instruments USA Inc., 1130 Ringwood Ct., San Jose, CA 95131; 800-888-0817; fax, 408-922-5835.

494 on reader service card

Tektronix Inc.



EDITORS' CHOICE

Tektronix Phaser 220e
Tektronix Phaser 220i
Tektronix Phaser 300i
Tektronix Phaser 440
Tektronix Phaser 480

Tektronix printers have long been among the best available for high-end color output for business users and graphics professionals alike. The five models in this year's crop maintain that tradition.

The Phaser 220e (\$3,995 list, \$3,650 street) and the somewhat faster Phaser 220i (\$5,995 list, \$5,279 street) offer thermal wax transfer technology at 600-by-300 dpi. The super B-size Phaser 300i (\$9,995 list, \$8,258 street) offers solid ink technology that can print 300- by 300-dpi brilliant color output on any paper that will make it through the printer. The super A-size Phaser 440 (\$7,995) and super B-size Phaser 480 (\$14,995 list, \$12,895 street) offer photorealistic thermal dye transfer output at 300 by 300 dpi.



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► **S U M M A R Y O F F E A T U R E S**

High-End Color Printers

In alphabetical order by company

■ = YES □ = NO

	PC MAGAZINE EDITORS' CHOICE			PC MAGAZINE EDITORS' CHOICE		PC MAGAZINE EDITORS' CHOICE		PC MAGAZINE EDITORS' CHOICE	
	Brother HS-1PS Level 2 Color	DECcolorwriter 1000	Eastman Kodak ColorEase PS Printer	Fargo PrimeraPro Color Printer	Mitsubishi Shinko ColorStream DS/Plus CHC-S746i	Seiko Professional ColorPoint2 PSF model 14	Tektronix Phaser 220e	Tektronix Phaser 220i	
List price (base configuration)	\$8,995	\$3,999	\$6,495	\$1,895	\$15,500	\$16,499	\$3,995	\$5,995	
Dimensions (HWD, in inches)	16.8 x 23.1 x 18.6	11 x 13.4 x 17.5	12 x 16.8 x 21	5.8 x 13.8 x 10.2	13 x 19.5 x 17.5	13.5 x 18.9 x 21.9	11 x 17.5 x 13.4	11 x 17.5 x 13.4	
Weight (pounds)	110	40	60	16	104	77	40	40	
Printer technology	Solid ink	Thermal wax transfer	Thermal dye transfer	Thermal dye/ thermal wax transfer	Thermal dye transfer	Thermal dye/ thermal wax transfer	Thermal wax transfer	Thermal wax transfer	
Engine model	Brother HS-I	Tektronix/Sharp Model 4681	Proprietary (Eastman Kodak)	Proprietary (Fargo)	Shinko CHC-S745	Proprietary (Seiko Instruments)	Tektronix/Sharp Model 4681	Tektronix/Sharp Model 4681	
Controller	Brother HS-I PS 2	Info not available	Proprietary (Sun-designed)	N/A ¹	Proprietary (Quintar-designed)	Proprietary (Seiko Instruments)	Tektronix PXe series	Tektronix PXi series	
Processor	25-MHz IDT R3051	16-MHz AMD Am29000	40-MHz Sun SPARC	N/A ¹	25-MHz AMD Am29050	33-MHz Intel 80960 CF Superscalar	16-MHz AMD Am29000	24-MHz AMD Am29000	
Standard, maximum RAM	12MB, 44MB	8MB, 8MB	16MB, 16MB	32K, 32K	54MB, 134MB	24MB, 136MB	8MB, 8MB	10MB, 14MB	
Interfaces									
Parallel/serial port	■ ■	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	■ ■	
AppleTalk port	■	■	■	■	■	■	■	■	
Ethernet adapter available	■ (via third party)	Optional	Optional	Optional	Optional	Optional	□	Optional	
Token-Ring adapter available	■ (via third party)	□	□	□	□	□	□	□	
Automatic interface switching	■	■	■	□	■	■	■	■	
Simultaneously active ports	■	■	■	□	■	■	■	■	
Paper Handling									
Accepts plain paper	■	■	□	■	□	□	■	■	
Printable area (inches) on letter-size paper	8.2 x 10.3	8.1 x 10.6	8 x 8.9	8.5 x 9.3	8.2 x 8.9	8.3 x 8.9	8.1 x 10	8.1 x 10	
Printable super A-size area (inches)	8.5 x 11	8.1 x 10.6	8.0 x 9.6	8.5 x 11	8.5 x 11	8.5 x 11	N/A ²	N/A ²	
Printable area (inches) on legal-size paper	8.2 x 13.3	N/A ²	N/A ²	N/A ²	N/A ²	8.3 x 10.7	8.1 x 10.6	8.1 x 10.6	
Printable super B-size area (inches)	11.8 x 19.3	N/A ²	N/A ²	N/A ²	11.7 x 17.1	11 x 17	N/A ²	N/A ²	
Fonts and Features									
Highest PCL level	PCL 5C	N/A ²	N/A ²	N/A ²	N/A ²	N/A ²	PCL 5	PCL 5	
PostScript support	Level 2 clone	Adobe Level 2	Adobe Level 2	Adobe Level 2 (optional)	Level 2 clone	Adobe Level 2	Adobe Level 2	Adobe Level 2	
Maximum resolution in Postscript (dpi)	300 x 300	600 x 300	300 x 300	600 x 300	300 x 300	300 x 300	600 x 300	600 x 300	
Other emulations	HPGL, HPGL/2	HPGL	None	None	Shinko CHC-S745	None	HPGL	HPGL	
Number of Type 1 fonts provided	35	17	39	17	35	39	17	39	
Pantone-certified/Provides color separations	□ ■	■ □	□ □	□ □	□ ■	□ ■	■ □	■ □	
Resolution Enhancement									
Smooths text jaggies	□	■	N/A ³	N/A ³	N/A ³	■ (in thermal wax mode)	■	■	
Minimizes visibility of color dithering	□	■	N/A ³	□	N/A ³		■	■	
Creates sharp edges	N/A ³	N/A ³	□	□	■	■	N/A ³	N/A ³	
Customer Support									
Toll-free technical support	■	■	■	□	□	■	■	■	
Telephone support hours (eastern time)	11:00-7:00 M-F	8:30-8:00 M-F	8:00 A.M.-8:00 P.M. M-F	8:00-6:00 M-F	9:30-5:30 M-F	10:00-8:00 M-F	9:00-8:00 M-F	9:00-8:00 M-F	
Warranty (parts and labor)	1 year	1 year	1 year on-site (limited)	1 year	1 year	90 days on-site, 1 year return to depot	90 days on-site, 1 year return to depot	90 days on-site, 1 year return to depot	

N/A¹—Not applicable: The PC handles all processing of the printed image. N/A²—Not applicable: The product does not have this feature. N/A³—Not applicable: The product's print technology does not have this feature.

*The Fargo PrimeraPro Color Printer comes with either a parallel or an AppleTalk port.

All five printers offer Adobe PostScript Level 2.

The 220e and 220i are fraternal twins, the key differences being a 24-MHz processor and 10MB of memory in the 220i compared with a 16-MHz processor and 8MB of memory in the 220e. On our speed tests, throughput difference was minimal: 0.73 graphics pages per minute for the 220i and 0.69 gppm for the 220e. The more complex the image, however,

the more of an advantage the 220i should have.

In addition to producing brilliant, fully saturated color, the 220e and 220i offer 600- by 300-dpi resolution and enhancements to minimize dithering patterns and posterization. The result is unbeatable graphics, with barely visible dithering, and something approaching continuous-tone images for scanned photos. Cost per page for three-color coverage is a low 56

cents. Quite simply, the 220e and 220i (along with the DECcolorwriter 1000) offer the best-looking output of any thermal wax transfer printers that have passed through PC Labs.

Output from the 300i is in competition with that of the best thermal wax transfer printers, with slightly more obvious dithering because of the 300i's lower resolution, but more vibrant colors for graphics. Dithering is far less obvious

PRINTERS High-End Color

ENDS

PC MAGAZINE PC MAGAZINE PC MAGAZINE

Tektronix Phaser 300i Tektronix Phaser 440 Tektronix Phaser 480

\$9,995 \$7,995 \$14,995
13.5 x 27 x 25 11 x 17.5 x 13.4 13.4 x 22.4 x 20.5
90 46 93
Solid ink Thermal dye transfer Thermal dye transfer

Tektronix Model 4699 Tektronix/Sharp Model 4685 Tektronix/Mitsubishi Model 4686

Tektronix PXi series Tektronix PXi series Tektronix PXi series
24-MHz AMD 24-MHz AMD 24-MHz AMD
Am29000 Am29000 Am29000
10MB 22MB 16MB 64MB 32MB 64MB

Optional Optional Optional
Optional Optional Optional

8 x 10.5 8.3 x 10.4 8.2 x 10
8.0 x 13.5 9.6 x 13.3 N/A
11.6 x 17.5 N/A 11.9 x 17.2

PCL 5 N/A Adobe Level 2 N/A Adobe Level 2 N/A Adobe Level 2

300 x 300 300 x 300 300 x 300
HPGL None None
39 39 39

N/A N/A N/A

N/A

9:00-8:00 M-F 9:00-8:00 M-F 9:00-8:00 M-F

90 days on-site, 1 year return to depot 90 days on-site, 1 year return to depot 90 days on-site, 1 year return to depot

than for the less-expensive Brother HS-1PS we reviewed. thanks to resolution-enhancement features. Scanned photographs approach but don't quite reach photorealistic quality. Cost per four-color page at 50 percent coverage is a reasonable 42 cents.

Note that the Xerox and QMS color laser printers reviewed elsewhere in this issue, which also print on standard paper, have comparable output, but with higher

resolution. They cost about the same, so if you need A-size output exclusively, you're probably better off with one of the laser choices. But if you need images of up to 11.5 by 17.5 inches on super B-size paper or can make good use of the 300i's ability to print on any paper that can make it through the printer, then the 300i is the preferred choice.

The Phaser 440 offers a maximum image size of 9.3 by 12.7 inches on super A-size paper. Here too, image quality is the best we've ever seen for thermal dye transfer printers, with the test photo retaining all the detail, shading, and flesh tones of the original. Graphics offer brilliant color and crisp lines for text. Even the speed (0.3 gppm) was relatively good for the technology.

For graphic artists and others who need full-bleed B-size images, the 480 offers a maximum image size of 11.9 by 17.2 inches. The printer managed a respectable 0.3 gppm on our Graphics Speed test. Image quality is in the same league as that of the 440, with colors losing just a bit of detail in dark areas of the photo. More importantly, image quality was the best among the super B-size thermal dye transfer printers. □

► **Tektronix Phaser 220e.** List price: \$3,995; A-size cassette with ColorCoat ribbon and 500 sheets of perforated paper, \$195. **Phaser 220i.** List price: \$5,995; same options as above; 4MB proprietary SIMM, \$395; Ethernet for AppleTalk and NetWare, \$695; TCP/IP, \$295 (requires Ethernet). **Phaser 300i.** List price: \$9,995; universal 100-sheet cassette for up to 12- by 18-inch paper and 32 ink sticks, \$395; 4MB propriety SIMM, \$395; Ethernet for AppleTalk and NetWare, \$695; TCP/IP, \$295 (requires Ethernet). **Phaser 440.** List price: \$7,995; 16MB proprietary SIMM, \$1,595; Ethernet for AppleTalk and NetWare, \$695; TCP/IP, \$295 (requires Ethernet). **Phaser 480.** List price: \$14,995; 50-sheet A-size cassette (with 4-color transfer roll and starter pack of paper), \$995; 16MB proprietary SIMM, \$1,595; Ethernet for AppleTalk and NetWare, \$695; TCP/IP, \$295 (requires Ethernet). Tektronix Inc., 26600 SW Parkway, Mailstop 63-583, Wilsonville, OR 97070-1000; 800-835-6100, 503-682-7377; fax, 503-682-2980. Circle 495 on reader service card

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PRINTERS

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Color Conquers SOHO

The current crop of ink jet printers offers near-laser-quality text and excellent color output that in some cases rivals that of the more expensive printer technologies.



By Lori Grunin

Last year we spoke of ink jet printers expanding their niches. As ink jets further encroach on the territory occupied by dot matrix and personal laser printers, we must stop considering ink jet a niche market. There aren't as many ink jet printers to choose from as there are laser and dot matrix printers—we found 19 this year, compared with 29 dot matrix and 50 laser print-

ers. In all other respects, however—price, print quality, and color support—ink jet continues to strengthen its position as the printer of choice for the fast-growing SOHO (small office/home office) market.

All but one of the printers we look at in this section firmly target the SOHO user, offering low-cost solutions for good-quality monochrome output and, in many cases, color output. The exception is the \$1,699 HP DeskJet 1200C, from

Hewlett-Packard Co. (and its PostScript sibling, the HP DeskJet 1200C/PS), which, with its rated throughput of 6 pages per minute, top-notch color output, and network support, straddles quite a few market segments. Both the 1200C and 1200C/PS have the features and output quality to compete with most of the printers reviewed in the high-end color printer section of this issue—particularly the 1200C/PS, which comes with PostScript Level 2.

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REVIEW CRITERIA

To make it into this roundup, an ink jet printer had to be PC-compatible and had to have entered distribution channels between last year's annual printer issue and early September 1994. We received 19 printers from nine vendors.

The \$399 Lexmark ExecJet IIc, a three-color printer with 300-dpi resolution (600-by-300 in text mode), didn't arrive in time to meet our testing deadline. We did, however, examine it in First Looks (*PC Magazine*, October 25, 1994). Four other printers also did not make our testing deadline: Digital Equipment Corp.'s DECcolorwriter 500ic (\$499) and DECwriter 500i (\$399); Lexmark's IBM

ExecJet II 4076 (\$329); and Smith Corona's Coronajet (\$499).

You may not be able to find some printers here that came out in the past 12 months; chances are they have succumbed to the growing pains experienced by major vendors' product lines. Models such as the HP DeskJet 520 and the Epson Stylus 300 have fallen victim to the realignment of product marketing strategies.

CROWDING THE COMPETITION

Ink jet technology has matured to the point where vendors can leverage off older models in a product line to sell no-frills, inexpensive printers to the traditionally price-sensitive dot matrix buyer.

HIGHLIGHTS

Ink Jets

INK JETS ARE DISPLACING dot matrix printers as the technology of choice for budget-minded consumers. With street prices as low as \$200, home and SOHO users can get the quiet operation and quality output of an ink jet for just a few dollars more than an entry-level impact printer. They also get the convenience of cut-sheet paper feeding and the ability to print transparencies.

COST PER PAGE is dropping, with most ink jet printers dipping to less than five cents per page for consumables.

PRINT QUALITY is improving as vendors offer higher resolutions. Hewlett-Packard, for example, boasts

600 by 300 dpi in its entire line of ink jets. Other vendors, too, are upping the ante to deliver crisp text and band-free graphics. At present, the output quality of most ink jet printers approximates that of a 300-dpi, \$500 laser.

COLOR is the story this year. While last year only one ink jet printer offered color capabilities, now 10 of the 19 reviewed units do so. And it's affordable to boot: Six printers offer acceptable three-color output for \$439 to \$499.

FOUR-COLOR printing is a better bet if you can afford the extra cost. While three-color units use cyan, magenta,

As a result, ink jet prices are slowly backing dot matrix prices into a corner. While the lowest-priced ink jet in this section, the Canon BJ-100 Bubble Jet, lists for \$249 on the street, older models are available for less than \$200.

In many ways, ink jet printers are easier to use than dot matrix models. Since they handle cut-sheet paper, you needn't wrestle with tractor feeds and fanfold paper—although the wide-carriage Epson Stylus 1000 does offer a tractor option. Ink jet printers also handle a greater range of media, such as transparencies or glossy papers. The four-color \$549 Canon BJC-4000 Bubble Jet will even support printing on cloth in the near future.

While we haven't seen any major technological breakthroughs this year, ink jet vendors are constantly refining the quality of text and graphics printing. For example, all the Hewlett-Packard models reviewed in this section boast text resolution up to 600 by 300 dpi, and the Epson Stylus Color features a 720-dpi graphics-only mode. So while the output quality of most ink jet printers cannot compete with the average 600-dpi laser printer, it comes close to that of a 300-dpi, \$500 laser.

Throughput is also approaching that of low-end lasers. At 4.2 ppm, the Canon

and yellow inks to create all colors, four-color systems add a black cartridge. This yields better contrast and saturation; it also saves you the trouble of swapping out the color cartridge when you want to print a monochrome-only document.

MORE COLOR is the province of the high-end color ink jets. The Epson Stylus Color, for example, offers a 720-dpi graphics-only mode that (on special stock) delivers near-photographic-quality images. The HP DeskJet 1200C and 1200C/PS are in a class by themselves, boasting vivid plain-paper output that rivals the much more expensive thermal wax transfer printers used for high-end color imaging.

BJC-4000 Bubble Jet can match any 4-ppm laser, and at 7 ppm, the HP DeskJet 1200C stacks up pretty well against an 8-ppm laser. For the most part, however, these printers fall into the 2- to 3-ppm range for text and 1.5- to 2.5-ppm for graphics.

Finally, cost per page is dropping: 14 of 19 printers in this section have monochrome page costs of under five cents. And while \$0.21 to \$1.19 per page for 25 percent color coverage isn't cheap, it's far less expensive than the thermal wax and thermal dye alternatives.

THE COLOR OPTION

For \$500 you can get an ink jet printer that produces three-color output in addition to monochrome, or the discontinued but still available four-color HP DeskJet 550C.

Color is the most significant trend in the ink jet market: 10 of the 19 models in this roundup support color, compared with only one last year (and that one—the HP DeskJet 550C—was an Editors' Choice selection from the previous year). The increased demand for color can be partly attributed to prices falling and quality improving as the technology matures, but it also reflects increasingly high-quality color support within mainstream word processing and spreadsheet applications, the growing use of presentation software, and the penetration of more powerful computers into the home—where plain old black and white is boring.

From the supply side, the most overt indicator of the importance of color is Hewlett-Packard's "color capability for all" strategy, epitomized by the company's pulling the monochrome-only DeskJet 520 out of the market to make way for the DeskJet 540. The DeskJet 540 ships as a monochrome printer but can be upgraded to three-color for \$49. A three-color printer can be an extremely attractive buy; if you're on a budget but may want to print color occasionally, the five three-color printers reviewed here, priced from \$379 to \$499, are worth a look. Less expensive than their four-color siblings, three-color ink jets use a CMY cartridge that you swap with a black cartridge as necessary. To color-enable these printers, you generally purchase a color kit, which usually consists of a color cartridge plus a



Monochrome:

• Canon BJ-200e Bubble Jet

Affordable color:

• HP DeskJet 540

• HP DeskJet 560C

High-end color:

• HP 1200C/PS

Ink jet printers have been improving so much that it was difficult to choose clear standouts in a given category. All the units we tested delivered good text out-

put at a reasonable cost of entry, and those with color kits (optional on some, standard on others) deliver passable to remarkable output.

Still, since the majority of users look to an ink jet for fast, crisp text output without the initial expense of a laser printer, we award an Editors' Choice designation to the Canon BJ-200e Bubble Jet printer (\$299 list). The follow-up unit to last year's Editors' Choice (the BJ-200), the BJ-200e delivers the same clean text output but now has better monochrome graphics. Its 360-dpi output showed no banding and better tonal range than the ones from competing units. Throughput of 86 cps and 2.0 gppm makes it one of the fastest ink jets we looked at. The one caveat is the high per-page cost of eight cents.

For monochrome output with the option to move to color, we award an Editors' Choice to the Hewlett-Packard DeskJet 540. Monochrome text and graphics output (while not quite up to that of the Canon) was good, though print speed was a little below par. But what we especially liked was the color option. Add just \$49 to the base list price of \$365 and you get a three-color kit for those times when you want to spruce up documents.

If you're going to be doing more than occasional spot color but still want an affordable printer, consider the HP DeskJet 560C (\$719 list, \$550 street). This Editors' Choice selection

uses a four-color system to deliver bright, well-saturated colors as well as true blacks. Graphics and transparency printing are particularly strong points, with good contrast and no banding.

We also think that the first runner-up in this class, the Epson Stylus Color, deserves an honorable mention. The unit is also very affordable (\$699 list, about \$600 street), and its color output in normal mode was excellent, though the colors were not as brilliant as those of the DeskJet 560C. But this Epson unit has a graphics-only mode that (on Epson's special paper) delivers 720-dpi output that approaches photographic quality—an amazing feat for a printer in this class.

For workgroups that require mixed color and text output, the HP DeskJet 1200C and its PostScript sibling, the 1200C/PS, are still in a class by themselves. New features since we awarded the 1200C/PS an Editors' Choice last year include Energy Star compliance, out-of-ink sensing, and improved halftoning. The four-color output is the best you'll see from this technology—and better than what most of the more-expensive thermal wax units offer. Throughput speeds are excellent (monochrome text speed rivals some 8-ppm laser printers), and costs per page are among the lowest of any ink jet. We tested the 1200C/PS, but we think the PCL-only 1200C will fulfill the needs of most users.

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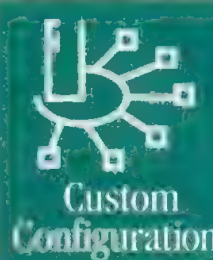
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Benchmark Tests: Ink Jets

When it comes to printing monochrome text and graphics, the DECcolorwriter 520ic, the Olivetti JP 450, and TI microMarc Color, which share the same basic design, were the overall leaders of the pack. The fastest printers for color output were the Canon BJC-600 Bubble Jet and Epson Stylus Color.

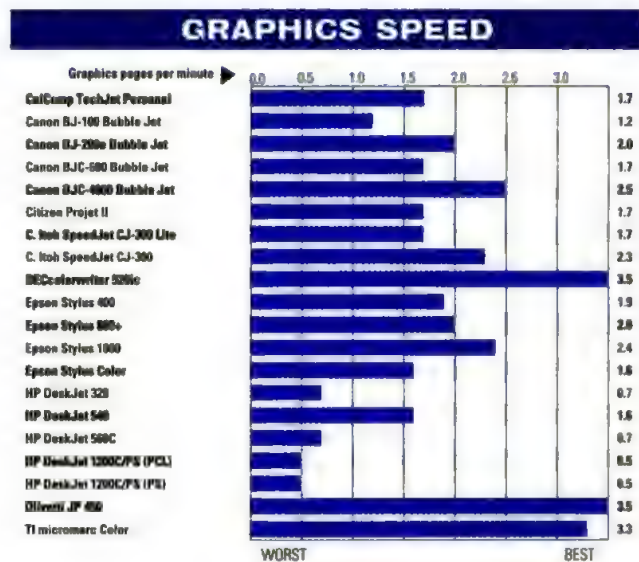
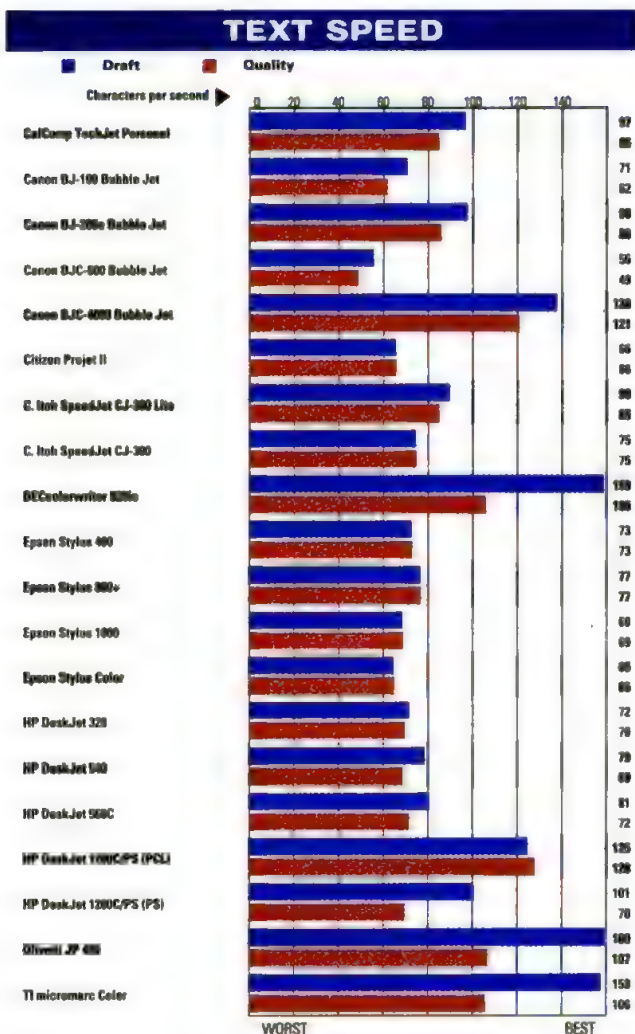
What the Numbers Mean

The fastest ink jet printer at producing letter-quality output was the Hewlett-Packard DeskJet 1200C/PS (in PCL mode), which produced 128 characters per second. The Canon BJC-4000 Bubble Jet produced 121 cps on our Text Speed test, followed by the Olivetti JP 450 at 107 cps, the DECcolorwriter 520ic at 106 cps, and the TI microMarc Color, also at 106 cps. The Digital, Olivetti, and TI units are of nearly identical design and showed virtually identical—and enviable—performance across the board. Bringing up the rear was the budget-priced Canon BJ-100 Bubble Jet printer, at 62 cps.

In past years, draft printing on ink jet printers meant reduced ink consumption but not faster speeds. This year, though, nearly all of the printers had a speed improvement in draft mode. The top performers on our Text Speed test were the Digital, Olivetti, and TI entries: Each one of them delivered a score of about 160 cps. The slowest performer was the Canon BJC-600 Bubble Jet, which scored 56 cps in draft mode.

On our Graphics Speed test we again found that the Digital, Olivetti, and TI were at the top of the list. Their amazingly fast throughput at or approaching 3.5 graphics pages per minute rivals that of 8-ppm laser printers. Surprisingly, the fastest quality-text printer, the HP DeskJet 1200C/PS, proved to be the worst performer on this test, producing just 0.5 gppm.

On our Microsoft Windows applications tests, a printer's performance—or lack thereof—is attributable to the efficiency of its Windows drivers. One of the three musketeers, the DECcolorwriter 520ic, proved the fastest here. Throughput of 143 cps on the Word for Windows test and 2.0 gppm on the Lotus 1-2-3 test were the best overall, and its 1.7 gppm showing on the CorelDRAW test was a close second to the 1.8 gppm of the Epson Stylus 1000. The C. Itoh SpeedJet CJ-300 Lite proved to be the weakest on Word for Windows and Lotus 1-2-3 printing, delivering just 48 cps and 0.6 gppm. CorelDRAW was a stumbling block



for all the HP ink jets we looked at, most notably the HP DeskJet 320 (0.2 gppm).

When we turned on the color printing setting for the color-capable printers in the group and ran the Lotus 1-2-3 test a second time, we saw a significant degradation in speed. The Canon BJC-600 Bubble Jet, for example, slowed down 83 percent—from a good 1.2 gppm to 0.2 gppm. In color mode, the fastest printers that we tested were the Canon BJC-600 Bubble Jet and the Epson Stylus Color, both at 0.7 gppm.

How We Tested

The **Text Speed** test measures the printer's speed in producing one copy of a two-page business letter with 1-inch margins in 10-cpi type. We ran the test twice, once in draft mode and once in quality mode.

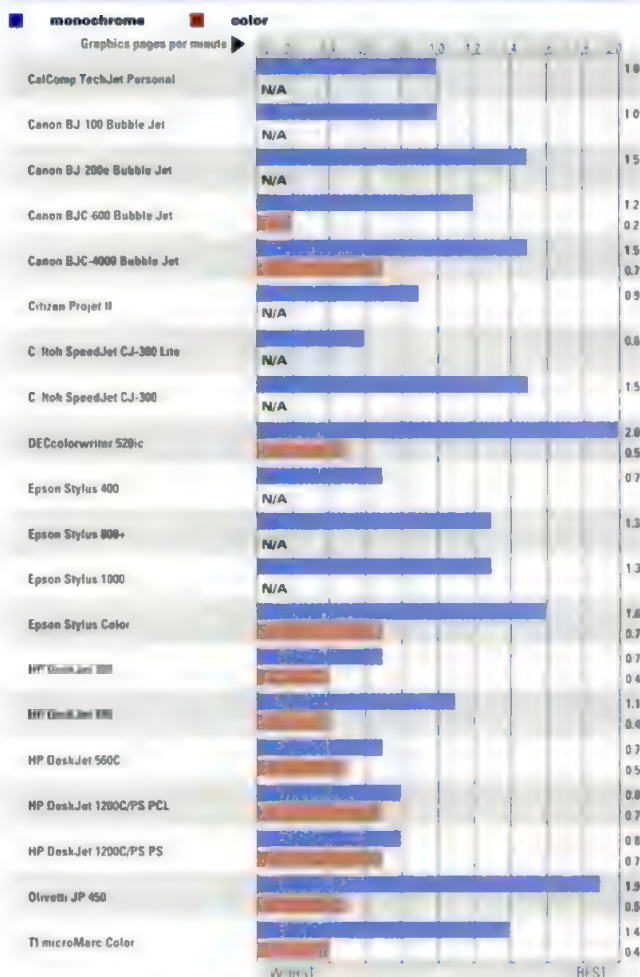
The **Graphics Speed** test measures the printer's speed in producing two copies of a complex single-page graphic containing a TIFF image, horizontal and vertical gray scales, and line art. A print file is sent to the parallel port directly from DOS.

The **Word for Windows** test measures the printer's speed in producing a two-page report that uses multiple fonts and type styles. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

The **Lotus 1-2-3 for Windows** test measures the printer's speed in producing a complex two-page spreadsheet that contains pie, bar, and line charts. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

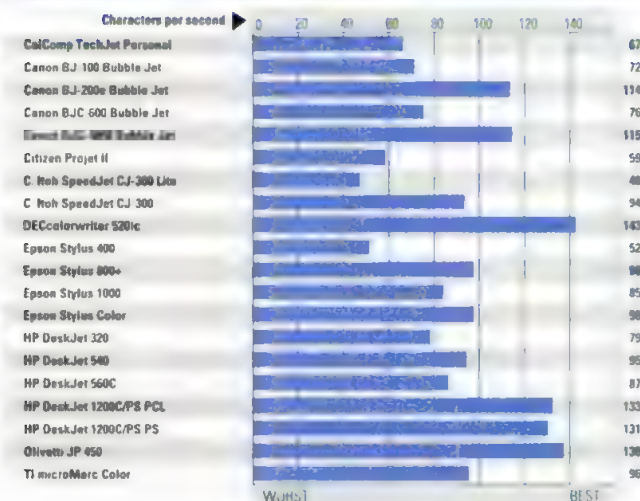
The **CorelDRAW** test measures the printer's speed in producing a single-page CorelDRAW graphic that contains a TIFF image, horizontal and vertical gray scales, and line art. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

LOTUS 1-2-3 FOR WINDOWS

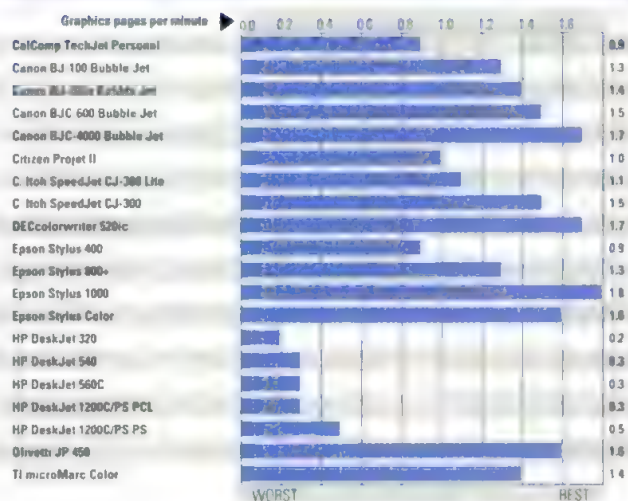


N/A: Not applicable. The printer does not have color capabilities.

WORD FOR WINDOWS



CORELDRAW



carrier that holds the ink cartridge when it is not in use.

Since three-color printing inherently yields poorer quality than four-color—the addition of black increases contrast and allows for more vibrant colors—it's not intended for serious graphics work. But this crop of three-color ink jets yields output that is quite attractive for the price; it's better than the output we've seen in previous years and certainly better than the dot matrix equivalent.

When shopping for a three-color ink jet printer, look for one that alerts you when you're trying to print black text pages with the color cartridge—whether by beeping, flashing a light on the control panel, or popping up a dialog box in your face. (The HP DeskJet 540 and 320, the DECcolorwriter 520ic, the Olivetti JP 450, and the TI microMarc Color all have this feature.) If a printer doesn't have this feature, it prints a composite black by combining cyan, yellow, and magenta; this usually comes out a muddy green and consumes excessive amounts of ink. Also, make sure that swapping ink cartridges doesn't involve recalling esoteric sequences of button combinations on the front panel.

THE K FACTOR

If you have a little more money to spend, opt for a four-color model. Since you don't have to swap cartridges, you can print black text and color graphics on the same page—and you'll be amazed at how good the graphics look.

Canon, Hewlett-Packard, and Epson are the primary contenders for the four-color crown; their four-color printers all produce very good color output. The Epson Stylus Color yields the best images when it's printing at 720 dpi (which requires special paper) and using Microweave mode, which moves the head in smaller vertical increments. Its transparency output, on the other hand, was merely adequate, with visible printhead tracking.

Don't underestimate the role of the driver, however, especially when it comes to color printing. Look for a printer that offers diffusion dither in its setup routine. Diffusion dither mixes C, M, and Y using a seemingly random dot pattern rather than a fixed one, which produces patches of colors with a smoother-looking, less

dotty appearance. Some drivers (like HP's and Canon's, for instance) also offer a *screen-match* color mode. The term is a bit misleading, however, since you don't calibrate your monitor and printer; this mode seems to increase the contrast of images or darken the colors a bit.

All the four-color printers reviewed here offer diffusion dither. And while the Hewlett-Packard printers can't match the Epson in raw resolution, HP's ColorSmart driver option, which automatically chooses the appropriate dither (dot pattern) and color mode (vivid or screen-match) based on page content, makes it exceptionally easy to get great results.

While most of the color printers here use a single cartridge to hold all three color inks, the HP DeskJet 1200C and the Canon BJC-600 use four separate cartridges. The BJC-600 goes one step further and separates the printhead from the ink tanks. Separating the colors makes setup a little more complicated but could save you money in the long run since you replace only the dry ink cartridge—not all four—when one color runs out.

Ink jet printers have come far in the few short years that they've been available for the mass market, but they still have to grow away from their dot matrix roots. For instance, with the exception of the HP DeskJet 540's software-based control panel, all of these units still use traditional, confusing indicators and hard-to-remember button combinations on their front panels. Many of them still require you to flip DIP switches to switch emulations in DOS. And in some cases, envelope handling is abysmal. Most require you to flip at least one paper-thickness lever, and sometimes another, to indicate manual feed. The ritual for loading envelopes into the Epson Stylus Color is particularly cumbersome, requiring you to take the printer off-line in order to flip the paper guide. Few of these printers make it easy to feed the envelopes manually. Despite their shortcomings, however, the benefits of ink jet printers still outweigh their costs.

CalComp

• TechJet Personal

BY TED NEEDLEMAN

Need both a printer and a small-format plotter? CalComp's versatile TechJet

Personal (\$699 list, \$600 street) monochrome ink jet can be used as both. The 360-dot-per-inch unit handles A-size (letter-size) paper, tabloid-size paper (11 by 17 inches), envelopes, and everything in between with ease. Once business users discover the joys of printing a large spreadsheet in landscape mode on 11-by-17-inch media, they may never go back.

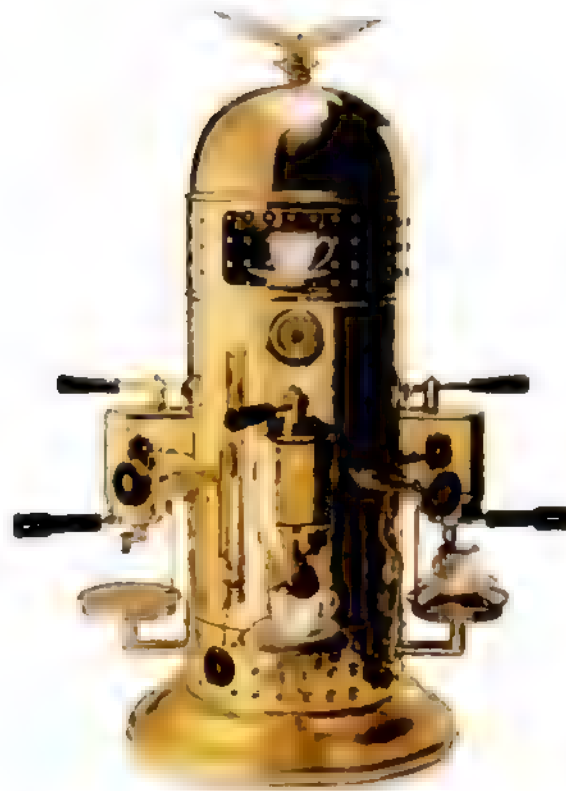
On our tests, the printer's Canon engine put out an admirable 85 characters per second in quality mode, the second-fastest we saw. Graphics printing speed, though, was near the bottom of the range at 1.7 graphics pages per minute. Text output was outstanding, even in draft mode. In quality mode, characters were crisp and clean, even on rounded letters. Graphics output on plain paper was disappointing, however. Gray-scale images showed obvious banding, coverage was not complete on solid blacks, and the resolution looked worse than the unit's



claimed 300 dpi. On coated media, graphics on the TechJet fared better but still not as good as others we saw.

The TechJet offers three printer emulations (Canon BJ-10, Epson LQ, IBM Proprinter X24E), and CalComp has made this printer compatible with just about any application that currently supports a monochrome plotter; numerous drivers are included for DOS, Microsoft Windows, and even Sun. With the Windows driver installed, we were able to print easily in landscape mode across the 17-inch width of the paper. You can even print side-by-side spread pages in landscape mode from most desktop publishing programs.

The TechJet's vertical design takes up only a small amount of desk space (7.9 by 16.9 by 8.2 inches), though adding the wire paper catcher for large media adds another 13 inches to the footprint's depth.



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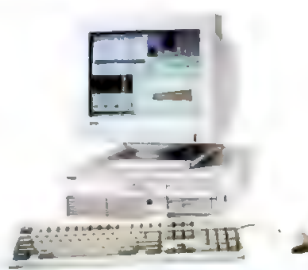
Celebris 466/4100

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- **Processor:** IntelDX2,™ IntelDX4™
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- **Secondary cache:** 256KB
- **Hard disk:** 270MB (540MB optional)
- **Slots:** 1 ISA, 1 PCI/ISA, 1 PCI
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- **Monitor:** 14" SVGA color
- **Software:** Pre-installed MS-DOS® & Windows™ for Workgroups

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- **Processor:** Pentium™
- **Disk drive:** 3.5" 1.44MB
- **Bus:** PCI/ISA
- **RAM:** 8MB to 128MB
- **Secondary cache:** 256KB to 512KB
- **Hard disk:** 270MB (540MB optional)
- **Slots:** 1 ISA, 1 PCI/ISA, 1 PCI
- **Graphics:** S3 864 with Hawkeye drivers
- **Monitor:** 14" SVGA color
- **Software:** Pre-installed MS-DOS & Windows for Workgroups

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Celebris 590

- **Chassis:** Full Profile
- **Processor:** Pentium™
- **Disk drive:** 3.5" 1.44MB
- **Bus:** PCI/ISA
- **RAM:** 8MB to 128MB
- **Secondary cache:** 256KB to 512KB
- **Hard disk:** 540MB
- **Slots:** 3 ISA, 1 PCI/ISA, 1 PCI
- **Graphics:** S3 864 with Hawkeye drivers
- **Monitor:** 14" SVGA color
- **Software:** Pre-installed MS-DOS & Windows for Workgroups

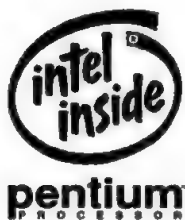
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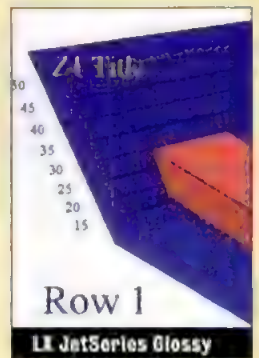
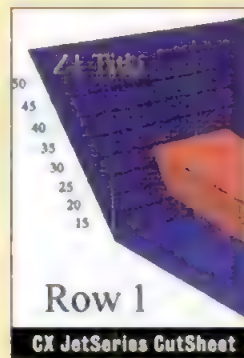
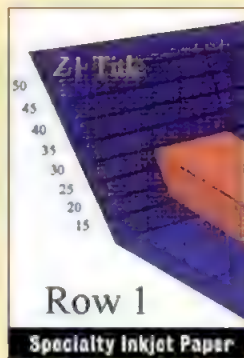
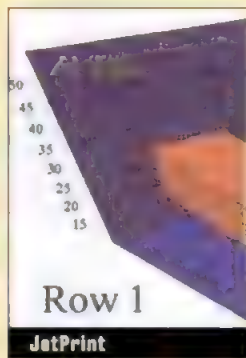
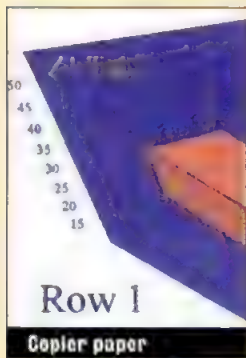
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Does Paper Make a Difference?



By Ted Needleman

Owners of ink jet printers know that most vendors recommend their own special paper for the best output. Do you really get noticeably better results from special paper than you do from standard copier paper? And, more importantly, does it matter whose special paper you use? To answer these questions, we talked to several major vendors and ran a variety of different papers through our Editors' Choice Hewlett-Packard DeskJet 560C. In a nutshell, our results back up the vendors' claims.

SNAP, CRACKLE, POP

To understand why paper affects ink jet output, it's important to understand one fundamental feature of ink jet technology: It involves firing droplets of liquid ink directly at the paper surface. As the ink moves away from the printhead it forms a spherical shape that flattens out when it hits the paper. The shape of the dot depends as much on the surface finish of the paper as on the viscosity (thickness) of the ink. Depending on the paper you use, the dot may stick to the paper, bounce off the paper, or bead up on the surface. The first scenario can produce a dot with a near-perfect shape; the second produces a fuzzy dot; the third forms a tiny pile of ink that often doesn't dry completely, so that small amounts break off or smear.

All the vendors we talked to admitted that plain copier paper also helps cause a condition called *wicking*. Wicking happens when the ink is absorbed too far into the paper, causing it to appear somewhat dull and fuzzy around the edges. Sometimes it can even seep through the paper and become visible from the rear, or, even worse, seep into a page resting behind the page just printed. Heavily wicked pages also tend to wrinkle.

In a perfect world, the dot would expand to the exact size desired and dry immediately, producing an image that is crisp, sharp, and, in the case of a color printer, bright. Vendors call this *snap* and try to achieve it by tailoring their special papers to the characteristics of their inks. According to Dan Halkyard of Rexham Graphics, the purpose of a coated paper is to ensure the right amount of ink penetration and drying. Edie Dees, Epson's Group Product Manager for printers, agrees, but feels that for best results the vendor needs to go even further. To enable its new Color Stylus to achieve 720-dpi resolution, Epson coordinated its specially coated paper with its ink formulation, the piezoelectric printhead, and even the printer driver software.

AND THE WINNER IS . . .

We ran five different papers through the HP DeskJet 560C: inexpensive copier paper, Hammermill Papers' JetPrint ink jet paper, Rexham Graph-

ics' Specialty Inkjet Paper, Hewlett-Packard's CX JetSeries CutSheet Paper, and Hewlett-Packard's LX JetSeries Glossy Paper. For each of the runs, we set the HP's printer driver for the type of paper used: Plain Paper for the copier paper; Special Paper for the JetPrint, Rexham, and CX paper; and Glossy Paper-Extra Drying Time for HP's LX paper.

Not surprisingly, the crispest colors and sharpest small text and lines were achieved with the almost \$1-per-sheet LX paper. HP's own CX paper and Rexham's specialty ink jet paper, both of which run about 10 cents a sheet, produced the second-best results, though color snap was noticeably poorer compared with the glossy paper. At about 1 cent a sheet, Hammermill's JetPrint gave acceptable results, but the colors were noticeably duller and the appearance was less crisp due to some wicking. Finally, standard copier paper gave the poorest results—though for many applications, the output would be perfectly usable. Though it's not evident from the reproduction, there was a significant amount of warp in the sample printed on the inexpensive copier paper.

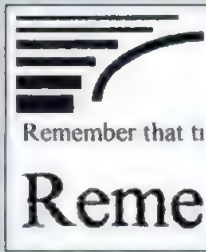
Our conclusion: When it comes to ink jet printing, paper does make a difference. Whether the difference matters depends on the look you want to achieve, the paper you use, and your wallet. □

GaiComp TechJet Personal**\$699****54-nozzle monochrome ink jet printer capable of B-size printing with PostScript Level 1 clone**

Draft Text Speed: 97 cps
 Quality Text Speed: 85 cps
 Graphics Speed: 1.7 gppm

WINDOWS APPLICATIONS:

Word for Windows: 67 cps
 Lotus 1-2-3 for Windows:
 1.0 gppm
 CorelDRAW: 0.9 gppm

**Canon BJC-4000 Bubble Jet****\$549****136-nozzle monochrome and four-color ink jet printer capable of legal-size printing**

Draft Text Speed: 138 cps
 Quality Text Speed: 121 cps
 Graphics Speed: 2.5 gppm

WINDOWS APPLICATIONS:

Word for Windows: 115 cps
 Lotus 1-2-3 for Windows:
 1.5 gppm (0.7 gppm color)
 CorelDRAW: 1.7 gppm

**Canon BJ-100 Bubble Jet****\$249****64-nozzle monochrome ink jet printer capable of legal-size printing**

Draft Text Speed: 71 cps
 Quality Text Speed: 62 cps
 Graphics Speed: 1.2 gppm

WINDOWS APPLICATIONS:

Word for Windows: 72 cps
 Lotus 1-2-3 for Windows:
 1.0 gppm
 CorelDRAW: 1.3 gppm

**Citizen Project II****\$299****50-nozzle monochrome ink jet printer capable of legal-size printing**

Draft Text Speed: 66 cps
 Quality Text Speed: 66 cps
 Graphics Speed: 1.7 gppm

WINDOWS APPLICATIONS:

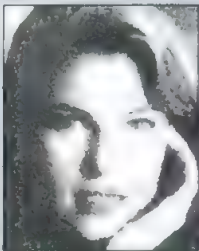
Word for Windows: 59 cps
 Lotus 1-2-3 for Windows:
 0.9 gppm
 CorelDRAW: 1.0 gppm

**Canon BJ-200e Bubble Jet****\$299****64-nozzle monochrome ink jet printer capable of legal-size printing**

Draft Text Speed: 98 cps
 Quality Text Speed: 86 cps
 Graphics Speed: 2.0 gppm

WINDOWS APPLICATIONS:

Word for Windows: 114 cps
 Lotus 1-2-3 for Windows:
 1.5 gppm
 CorelDRAW: 1.4 gppm

**C. Itch ProWriter SpeedJet CJ-300 Lite****\$299****128-nozzle monochrome ink jet printer capable of legal-size printing**

Draft Text Speed: 90 cps
 Quality Text Speed: 85 cps
 Graphics Speed: 1.7 gppm

WINDOWS APPLICATIONS:

Word for Windows: 48 cps
 Lotus 1-2-3 for Windows:
 0.6 gppm
 CorelDRAW: 1.1 gppm

**Canon BJC-600 Bubble Jet****\$579****256-nozzle monochrome and four-color ink jet printer capable of legal-size printing**

Draft Text Speed: 56 cps
 Quality Text Speed: 49 cps
 Graphics Speed: 1.7 gppm

WINDOWS APPLICATIONS:

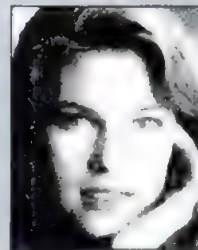
Word for Windows: 76 cps
 Lotus 1-2-3 for Windows:
 1.2 gppm (0.2 gppm color)
 CorelDRAW: 1.5 gppm

**C. Itch ProWriter SpeedJet CJ-300****\$419****128-nozzle monochrome ink jet printer capable of legal-size printing**

Draft Text Speed: 75 cps
 Quality Text Speed: 75 cps
 Graphics Speed: 2.3 gppm

WINDOWS APPLICATIONS:

Word for Windows: 94 cps
 Lotus 1-2-3 for Windows:
 1.5 gppm
 CorelDRAW: 1.5 gppm



DECcolorwriter 520ic**\$449****50-nozzle monochrome and three-color printer capable of letter-size printing**

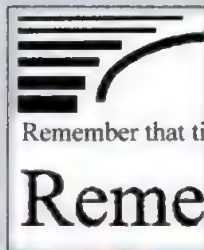
Draft Text Speed: 159 cps
 Quality Text Speed: 106 cps
 Graphics Speed: 3.5 gppm

WINDOWS APPLICATIONS:
 Word for Windows: 143 cps
 Lotus 1-2-3 for Windows:
 2.0 gppm (0.5 color)
 CorelDRAW: 1.7 gppm

**Epson Stylus Color****\$699****64-nozzle monochrome and four-color ink jet printer capable of legal-size printing**

Draft Text Speed: 65 cps
 Quality Text Speed: 65 cps
 Graphics Speed: 1.6 gppm

WINDOWS APPLICATIONS:
 Word for Windows: 98 cps
 Lotus 1-2-3 for Windows:
 1.6 gppm (0.7 gppm color)
 CorelDRAW: 1.6 gppm

**Epson Stylus 400****\$299****48-nozzle monochrome ink jet printer capable of legal-size printing**

Draft Text Speed: 73 cps
 Quality Text Speed: 73 cps
 Graphics Speed: 1.9 gppm

WINDOWS APPLICATIONS:
 Word for Windows: 52 cps
 Lotus 1-2-3 for Windows:
 0.7 gppm
 CorelDRAW: 0.9 gppm

**HP DeskJet 320****\$379****54-nozzle portable monochrome ink jet printer (with three-color option) capable of legal-size printing**

Draft Text Speed: 72 cps
 Quality Text Speed: 70 cps
 Graphics Speed: 0.7 gppm

WINDOWS APPLICATIONS:
 Word for Windows: 79 cps
 Lotus 1-2-3 for Windows:
 0.7 gppm (0.4 gppm color)
 CorelDRAW: 0.2 gppm

**Epson Stylus 600+****\$399****48-nozzle monochrome ink jet printer capable of legal-size printing**

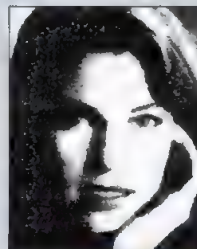
Draft Text Speed: 77 cps
 Quality Text Speed: 77 cps
 Graphics Speed: 2.0 gppm

WINDOWS APPLICATIONS:
 Word for Windows: 98 cps
 Lotus 1-2-3 for Windows:
 1.3 gppm
 CorelDRAW: 1.3 gppm

**HP DeskJet 540****\$365****54-nozzle monochrome ink jet printer (with three-color option) capable of legal-size printing**

Draft Text Speed: 79 cps
 Quality Text Speed: 69 cps
 Graphics Speed: 1.6 gppm

WINDOWS APPLICATIONS:
 Word for Windows: 95 cps
 Lotus 1-2-3 for Windows:
 1.1 gppm (0.4 gppm color)
 CorelDRAW: 0.3 gppm

**Epson Stylus 1000****\$599****48-nozzle monochrome ink jet printer capable of B-size printing**

Draft Text Speed: 69 cps
 Quality Text Speed: 69 cps
 Graphics Speed: 2.4 gppm

WINDOWS APPLICATIONS:
 Word for Windows: 85 cps
 Lotus 1-2-3 for Windows:
 1.3 gppm
 CorelDRAW: 1.8 gppm

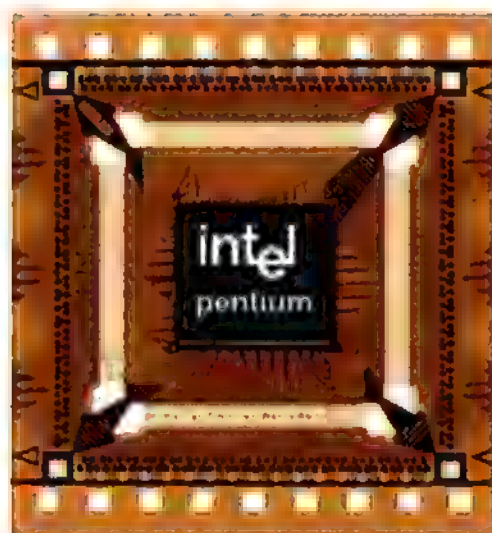
**HP DeskJet 560C****\$719****54-nozzle monochrome and four-color ink jet printer capable of legal-size printing**

Draft Text Speed: 81.0 cps
 Quality Text Speed: 72 cps
 Graphics Speed: 0.7 gppm

WINDOWS APPLICATIONS:
 Word for Windows: 87 cps
 Lotus 1-2-3 for Windows:
 0.7 gppm (0.5 gppm color)
 CorelDRAW: 0.3 gppm



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CIRCLE 379 ON READER SERVICE CARD

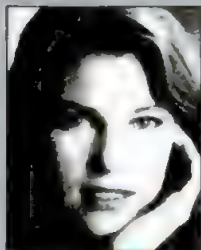
HP DeskJet 1200C/PS

\$2,428

108-nozzle monochrome and four-color ink jet printer capable of legal-size printing with PCL 5 and optional Adobe PostScript Level 2

Draft Text Speed: 125 cps
Quality Text Speed: 128 cps
Graphics Speed: 0.5 gppm

WINDOWS APPLICATIONS:
Word for Windows: 133 cps
Lotus 1-2-3 for Windows:
0.8 gppm (0.7 gppm color)
CorelDRAW: 0.3 gppm



Olivetti JP 450

\$499

50-nozzle monochrome and three-color ink jet printer capable of legal-size printing

Draft Text Speed: 160 cps
Quality Text Speed: 107 cps
Graphics Speed: 3.5 gppm

WINDOWS APPLICATIONS:
Word for Windows: 138 cps
Lotus 1-2-3 for Windows:
1.9 gppm (0.5 gppm color)
CorelDRAW: 1.6 gppm



Most users may elect to leave off the paper catcher.

If you don't need the exceptional range of paper sizes this unit can handle, a more traditional and less expensive ink jet is a better bet. But if you can use its large-format or plotter features and graphics printing is not a priority, the CalComp TechJet Personal is a good value.

► **TechJet Personal.** List price: \$699. CalComp, 2411 W. La Palma Ave., Anaheim, CA 92801; 800-932-1212, 714-821-2000; fax, 800-451-7568.

Circle 444 on reader service card

Canon Computer Systems Inc.

• **Canon BJ-100 Bubble Jet**

EDITORS' CHOICE
Canon BJ-200e
Bubble Jet

• **Canon BJC-4000**
Bubble Jet

• **Canon BJC-600**
Bubble Jet

BY LORI GRUNIN

When it comes to ink jet printing, Canon's got something for everyone. The budget monochrome BJ-100 (\$249 list) is a good choice for individuals and small-office/home-office users. The BJ-200e (\$299 list) offers those users faster throughput and better output quality for just a few dollars more. Small-business users and individuals who need color output should consider the BJC-4000 (\$549 list). We were disappointed only with the BJC-600 (\$579 list), aimed at graphics-intensive users.

Text and graphics output from the BJ-100 were acceptable. Characters

were well formed, but we did notice some ink bleeding in quality mode. Output was slow: 62 characters per second and 1.2 graphics pages per minute in quality mode. Paper (up to 8.5 inches wide) feeds through the built-in 100-page sheet feeder; envelopes have a tendency to feed crookedly. Also, cost per page with this low-priced unit is a high 8 cents.

Die-hard monochrome buyers will find the BJ-200e hard to resist. The follow-up unit to last year's Editors' Choice-winning BJ-200 (for more information, see *PC Magazine*, November 23, 1993), its throughput of 86 cps in letter quality and 2.0 gppm makes it one of the fastest monochrome-only units. Text is excellent—extremely crisp characters and little bleeding. The BJ-200e boasts multi-pass printing and an improved software driver to deliver better graphics; indeed, the 360- by 360-dot-per-inch gray-scale graphics show no banding and a broader

tonal range than we saw from the monochrome Epsoms or the HP DeskJet 540. Here again, though, cost per monochrome page is a steep 8 cents.

The BJC-4000 provides an attractive option for budget-conscious users who need four-color printing. With output speeds of 120 cps letter quality and 2.5 gppm, the printer easily outpaces the DECcolorwriter 520ic and HP DeskJet 560C, as well as the slowest laser printers. It also handles the widest variety of media types, including back-print film and cloth, which we did not test. Cost per monochrome page is a low 4 cents, and color will set you back a reasonable 26 cents a page (for 30 percent coverage).

The BJC-4000 automatically switches between its two ink cartridges (one high-capacity black, one four-color), which share the printhead carrier. Color images are sharp and well rendered in the printer's 360- by 360-dpi resolution—not quite as vivid as those produced by the HP or the Epson color units, but with truer colors than the BJC-600. The Windows driver, similar to that of the BJC-600, offers color and screen-match color options to optimize output. You can also choose an



Canon BJC-4000 Bubble Jet

intensity setting and pick between two pattern dithers and a diffusion dither. The printer also comes with 20 Bitstream TrueType fonts and an on-line guide for Windows that gives you step-by-step instructions for all operations.

The BJC-600 does not seem to merit the extra cost over the BJC-4000. Targeted at the graphics-intensive user, this unit's monochrome image output is a middling 1.7 gppm, while its color output of 0.2 gppm is the slowest we saw. It's also a text slug—49 cps for letter-quality text; again, the slowest of the lot. And, while vivid, the colors are not very accurate (especially blues). Printing costs per page are low, however: 3 cents for monochrome and about 15 cents for color at 30 percent coverage.

► **Canon BJ-100 Bubble Jet.** List price: \$249. **Canon BJ-200e Bubble Jet.** List price: \$299; ink cartridge, \$25. **Canon BJC-4000 Bubble Jet.** List price: \$549; BC-20 ink cartridge, \$29; BC-21 ink cartridge and printhead, \$50. **Canon BJC-600 Bubble Jet.** List price: \$579; black ink, \$7.50; cyan, yellow, and magenta inks, \$8 each. Canon Computer Systems Inc., 2995 Redhill Ave., Costa Mesa, CA 92626; 800-848-4123, 714-438-3000; fax, 714-438-3099.

Circle 445 on reader service card

Citizen America Corp.

● Citizen Project II

BY TED NEEDLEMAN

With the Project II, Citizen didn't set out to build the best or fanciest monochrome ink jet printer; it set out to build an inexpensive one. Priced at \$299 (\$255 street), the unit was one of the least expensive ink jets in this roundup. Though not a features leader, the Project II nonetheless delivers good 300-dot-per-inch output at acceptable speeds.

The printer offers 13 resident fonts, only a single emulation—HP DeskJet Plus (PCL 3)—and several quirks. The factory default setting, for example, is for ink-saving 150-dpi draft mode; you have to reset it if you want 300 dpi. The Project II also uses an unusual two-piece printhead/print cartridge combination. Citizen says this approach saves money on consumables since the printhead will last through 12 ink cartridges. Cost per page is about 3 cents, among the lowest in the group. To change



default settings, the Project II has a series of push-pull switches instead of the more common DIP switches.

At 300 dpi, the Project II gives a fairly good image and clean text. We observed only slight ink spray on text, though gray-scale graphics had some noticeable banding. Our tests showed the Project II's output speed to be 66 characters per second for text and 1.7 graphics pages per minute for graphics—near the bottom of the pack. The basic paper-handling choices are a 70-page sheet feeder for letter-, legal-, and A4-size paper, and a front feed slot; the unit accepts No. 10 envelopes and transparencies.

The Project II's compact footprint (14.5 by 13.5 inches) lets it sit unobtrusively on your desk. But its most endearing feature is its price.

► **Citizen Project II.** List price: \$299; 256K RAM upgrade, \$175; printhead and one ink cartridge, \$35; two-pack ink cartridge, \$16. Citizen America Corp., 2450 Broadway, #600, P.O. Box 4003, Santa Monica, CA 90411; 310-453-0614; fax, 310-453-2814.

Circle 446 on reader service card

C-Tech Electronics Inc.

● C. Itoh ProWriter SpeedJet CJ-300 Lite

● C. Itoh ProWriter SpeedJet CJ-300

BY TED NEEDLEMAN

Aimed squarely at the small-office/home-office market, the \$419 C. Itoh ProWriter SpeedJet CJ-300 (\$325 street) and \$299 C. Itoh ProWriter SpeedJet CJ-300 Lite (\$250 street) monochrome printers offer excellent print quality and acceptable output speed. The units offer only PCL 3 emulation and basic paper-handling options but are good choices if your needs are few

and your budget is limited.

C-Tech provides its DOSPANEL setup utility, which makes configuring the CJ-300 Lite from DOS very straightforward. Both models ship with a Windows driver. Print quality from these 300-dot-per-inch units was fine. Jagged edges were noticeable on characters printed in draft mode, but letter-quality output was better, with just slight blurring. Graphics output was also good, with no visible bands or streaks, though some jaggedness was visible on the edges.

Under DOS, the pair performed similarly and about average among our test group. The CJ-300 was faster in producing graphics output (2.3 graphics pages per minute versus 1.7 gppm) while the CJ-300 Lite was a little faster on straight text (85



characters per second versus 75 cps). On our Word for Windows application test, however, the lower-priced CJ-300 Lite turned in one of the lowest scores (48 cps) while the CJ-300 maintained an acceptable 94 cps.

Besides faster graphics and Windows printing, the extra money for the CJ-300 gets you a serial interface option and more control-panel features, such as form-feed and line-feed. The 100-sheet input feeder of each printer can accept letter-size paper, legal-size paper, or transparencies, and a single-sheet feed slot accepts envelopes and other media.

Unlike vertically oriented ink jets on the market, the C. Itohs have a somewhat large footprint (15.6 by 13 inches), a consideration if space is a concern. Also, on our tests, we had difficulty in getting the CJ-300 Lite's printhead to prime from the control panel. When we installed the unit's DOSPANEL utility software, it primed immediately under software control.

► **C. Itoh ProWriter SpeedJet CJ-300 Lite.** List price: \$299; ink cartridge, \$45. C.

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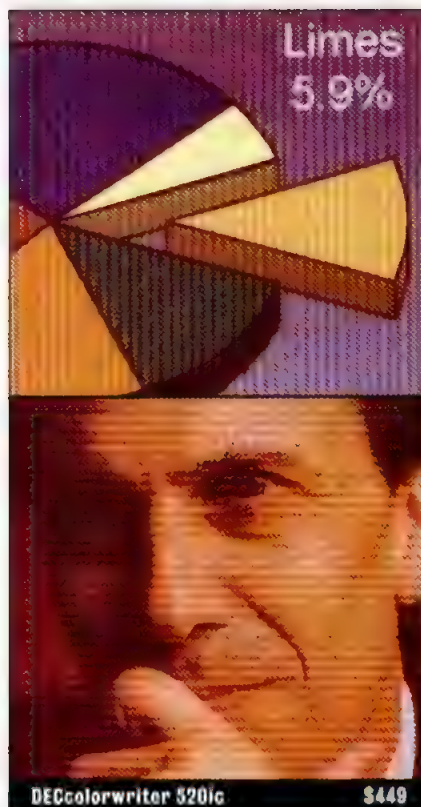
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Sound Blaster Discovery CD, Sound Blaster Edutainment CD, Game Blaster CD, Sound Blaster Digital Schoolhouse and the Sound Blaster holders. U.S. inquiries: 1-800-998-5227. International inquiries: Creative Technology Ltd., Singapore. TEL 65-773-0233 FAX 65-773-0353.

Color Output Samples

The three-color ink jet printers on this and the next page offer a wide range of output quality. Dithering patterns, which show most clearly in the light orange wedge in the pie chart, are obvious in some cases but not others. Color quality ranges from washed out

3 Color



Itoh ProWriter SpeedJet CJ-300. List price: \$419; ink cartridge, \$45. 128K RAM upgrade, \$85; 256K RAM upgrade, \$145. C-Tech Electronics Inc., 2701 Dow Ave., P.O. Box 2098, Tustin, CA 92681; 800-347-4017; fax, 714-757-4533.

Circle 447 on reader service card

Digital Equipment Corp.

DECcolorwriter 520ic

BY BRUCE BROWN

Good print quality and a reasonable price make Digital Equipment Corp.'s DECcolorwriter 520ic (\$449 list, \$400 street) a good choice if you need both monochrome and three-color output. With a duty cycle of 1,400 pages per month and a

handy 150-sheet paper tray standard, the 300-dot-per-inch 520ic is appropriate for office and home use. If you don't need color output, the monochrome-only DECwriter 500i lists for \$399.

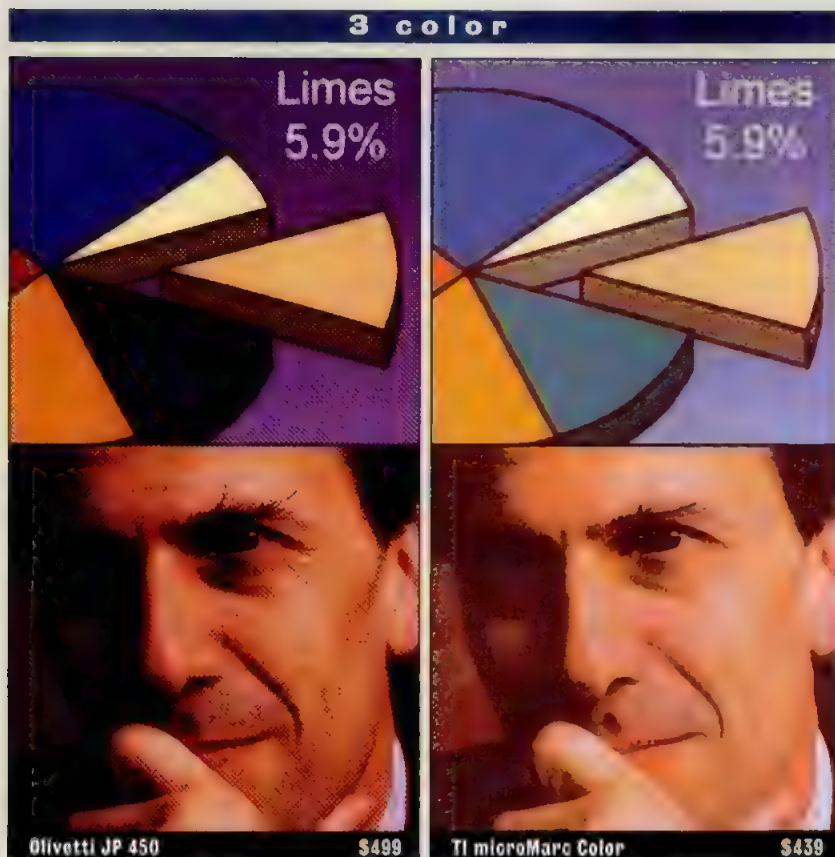
Rated at 5 pages per minute in draft



mode and 2 ppm in quality mode, the 520ic was at or near the top on all our throughput tests, both for text and graphics. Print quality in both monochrome and color is good, with no streaking and only slight blurring on plain paper. Text in monochrome-only documents is nicely dark, but in color mode the three-color composite black is less dark and shows halos of color around the edges. Colors looked vibrant, and color graphics were sharp. As with other ink jets, very dense graphics take a minute or more to dry.

The 150-sheet automatic paper feeder on the HP DeskJet 500C (PCL 3E)-compatible unit can handle letter-, legal-, and A4-size paper, as well as transparencies, labels, and envelopes. Printing costs per

to too dark, without any truly vibrant colors. However, output from the HP DeskJet 320 and TI microMarc Color units is easily in the same class as the lesser output from four-color ink jet printers.



page average 5 cents for monochrome and 56 cents for color (at 25 percent coverage), which is higher than most other ink jets we looked at this year.

The printer automatically detects whether the monochrome or color ink cartridge is needed for a job, and a flashing light on the control panel warns you if the wrong one is installed; changing the cartridge is a simple 10-second affair. A control-panel LED also warns you when ink is running low.

Setup was glitch-free, and the default settings were fine for both monochrome text and color graphics printing. Three resident TrueType fonts and color and monochrome Windows drivers round out this solid offering.

► **DECcolorwriter 520ic.** List price: \$499; two-pack monochrome ink cartridge, \$12;

color ink cartridge, \$35. Digital Equipment Corp., 146 Main St., Maynard, MA 01754; 800-777-4343, 508-493-5111; fax, 800-234-2298.

Circle 448 on reader service card

Epson America Inc.

- **Epson Stylus 400**
- **Epson Stylus 800+**
- **Epson Stylus 1000**
- **Epson Stylus Color**

BY LORI GRUNIN

Based on Epson's own Stylus printing technology, which the company claims produces a more precise ink dot to reduce ink spray, these four units constitute Epson's entire venture into the ink jet market. The high-end Stylus Color is ideal

for professionals who need flawless four-color output. The remaining three monochrome units, while a snap to set up and configure, showed bleeding on text output.

At a street price of a little under \$600, the Stylus Color should suit presenters and other business users. Using one black and one three-color cartridge to produce 360- by 360-dot-per-inch resolution, this printer produces sharp, vivid images, albeit at a fair 1.6 graphics pages per minute. Overall, we found color vibrancy not quite up to that of the competing HP DeskJet 560C. On the other hand, near-photographic-quality images can be had in the unit's images-only 720-dpi mode, which requires proprietary paper. Text quality is equally good: sharp with absolutely no ink spray, although its throughput is an unremarkable 65 characters per second. Cost is a low 2 cents for monochrome and a reasonable 33 cents for color.

The well-designed Windows driver offers 180-, 360- and 720-dpi modes, as well as Microweave mode, which moves the printhead in half-height vertical increments for a finer image. An ink-saving Economy mode is accessible either via software or the front panel. The only significant flaw in the Stylus Color is its envelope handling. On the plus side, the envelopes feed in a stack. The loading process is too much of a production, however: You have to take the printer off-line, move the ink cartridge to its setup position in order to reach the paper thickness lever, remove the paper in the input tray, remove the paper guide, and reinsert the guide backwards before you can finally load the envelopes.

The three monochrome printers prove less impressive. Text print quality is strikingly similar—and disappointing. While none of their output suffers from ink spray, the ink tends to bleed on plain paper. Gray-scale graphics, on the other hand, show nice detail and no banding, except from the Stylus 800+.

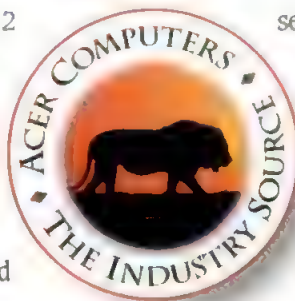
At a list price of \$299 (\$249 street), the Stylus 400 is intended for the price-sensitive buyer. With middling throughput of 73 cps and 1.9 gppm, though, it's recommended only for performance-insensitive users. Here again, feeding envelopes is an

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■ Color Output Samples, continued

Color quality for the four-color ink jet printers ranges from slightly washed out for the Canon BJC-4000 Bubble Jet to a pleasing pastel for the Epson Stylus Color to relatively vibrant colors for the HP DeskJet 560C and 1200C in PCL mode. Note too

4 Color



Canon BJC-600 Bubble Jet

\$579



Canon BJC-4000 Bubble Jet

\$549



Epson Stylus Color

\$699

unnecessarily complex procedure: You must move the ink cartridge to setup position in order to reach the paper thickness lever.

The \$359-list (\$299-street) Stylus 800+ (with a low cost per monochrome page of 3 cents) offers a slight speed improvement (77 cps and 2.0 gppm). Its Windows driver adds support for Microweave and high-speed modes.

A wide-carriage version of the Stylus 800+ that supports B-size paper in portrait orientation, the Stylus 1000 (\$599 list, \$449 street) also supports a push tractor for continuous-feed paper. Installing and operating the tractor is a snap, and you can feed from the cut-sheet feeder while the tractor has paper in it. Like the Stylus 800+, the Stylus 1000 offers an Economy mode and (thankfully) a simple proce-

cedure to single-feed envelopes.

Although Epson intended the Stylus 1000 to serve as a workhorse printer, only its 2.4-gppm throughput proves competitive; its 69-cps text throughput lands it close to the bottom of the pack. Similarly, the Stylus 800+'s minimalist driver does not meet the standard set by the newer



Epson Stylus Color

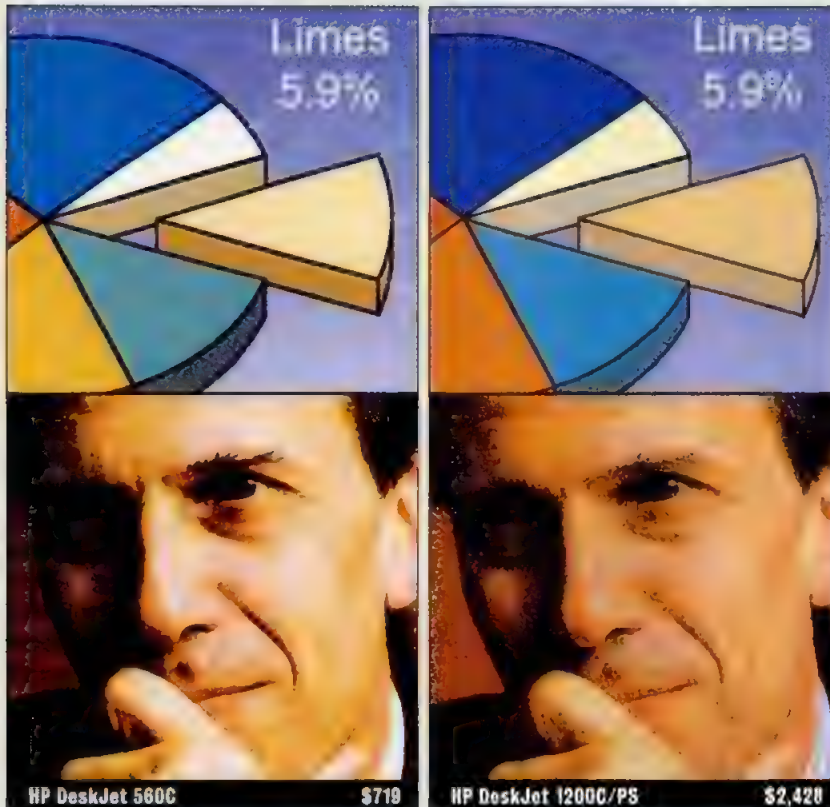
driver that ships with the rest of the Epson crowd.

► **Epson Stylus 400.** List price: \$299. **Epson Stylus 800+.** List price: \$359; ink cartridge, \$17.50. **Epson Stylus 1000.** List price: \$599; ink cartridge, \$17.50; push tractor, \$90; serial interface, \$88; 32K serial or parallel interface, \$152; coaxial interface, \$699; twinaxial interface, \$669. **Epson Stylus Color.** List price: \$699; black ink cartridge, \$17; color ink cartridge \$35; 360-dpi paper, \$21; 720-dpi paper, \$25; transparencies, \$55; media starter pack, \$18; serial interface, \$88; 32K serial or parallel interface, \$152; coaxial interface, \$699; twinaxial interface, \$669. Epson America Inc., 20770 Madrona Ave., Torrance, CA 90503; 800-289-3776, 310-782-0770; fax, 310-782-4248.

Circle 449 on reader service card

that dithering patterns are subtle enough in most cases so that the photos approach continuous-tone quality. The Epson Stylus Color comes closest when using its 720-dpi mode and special paper (not shown).

4 Color



Hewlett-Packard Co.

• **HP DeskJet 320**

PC EDITORS' CHOICE

HP DeskJet 540

HP DeskJet 560C

HP DeskJet 1200C/PS

BY LORI GRUNIN

In keeping with its new ink jet product policy—that every printer should be “color-capable”—Hewlett-Packard has revamped its entire line. The HP DeskJet 540 is a good choice for small-office/home-office users looking for an affordable monochrome ink jet with color capabilities. Users who need more than occasional spot color should consider the Editors' Choice HP DeskJet 560C. A for-

mer and current Editors' Choice selection, the HP DeskJet 1200C/PS (along with its non-PostScript sibling, the HP 1200C) is targeted at the departmental and workgroup markets. The portable HP DeskJet 320 provides monochrome or three-color printing on the road. All feature 600- by 300-dot-per-inch resolution and HP's ColorSmart technology, which analyzes the text and graphics mix on a page and optimizes output.

The totally new 540 (\$365 list) ships as a monochrome printer, but for \$49 you can add a color kit—simply a three-color ink cartridge to replace the standard black. The 540's lack of a front control panel distinguishes it from the rest of the printers in this roundup; you use a software utility to set all variables, including mode and media selection. All media

feeds from stacks through the front, with no need to flip any paper-thickness levers. The new design, combined with the software controls, makes the 540 one of the easiest ink jets to set up, and cost per page (3 cents monochrome, 21 cents for 25 percent color coverage) is low.

Ink spray and bleeding tend to obscure the benefits of the 540's 600- by 300-dpi resolution, but the output quality remains better than much of the monochrome and three-color competition. While green-tinting, the composite black is still good. The 540's monochrome speed is middle-of-the-road (69 characters per second in quality mode, and 1.6 graphics pages per minute), while its 0.4-gppm color throughput is slower than average.

Four-color brother to the 540, the \$719 (\$556 street) 560C uses a two-cartridge (one black, one three-color) system. Text quality is very good, but with more ink spray than the rest of its four-color competition. Graphics and transparency printing are excellent: The 560C yields good tonal range and well-balanced contrast on all papers, with no visible banding. The 560C also produced the most vibrant colors of all the four-color printers tested. With text throughput of 71.6 cps, monochrome graphics speed of 0.7 gppm, and color speed of 0.5 gppm, the unit is on the slow side.

Although it does not have a new name, HP has updated its standard-setting DeskJet 1200C (\$1,699 list, \$1,399 street) and the DeskJet 1200C/PS (add \$729 for the PostScript Level 2 module) color ink jets; new features include Energy Star compliance, out-of-ink sensing, improved halftoning, and improved handling of sequential print jobs. Both printers use a four-cartridge system, and their color print quality is the best you'll see from an ink jet. In fact, image quality surpassed



SUMMARY OF FEATURES

CONTINUES

Ink Jets

In alphabetical order by company

■ = YES □ = NO

List price (base configuration)

Dimensions (HWD, in inches)

Weight (pounds)

Number of jets

Maximum resolution (dpi)

Parallel/serial port

Printer-specific Windows 3.1 driver

Paper Handling

Maximum paper width (inches)

Rated maximum paper weight (pounds)

Can print on card stock/transparencies

Can print on B-size paper/envelopes

Pressure/tractor paper feed

Paper paths

Landscape printing

Fonts and Features

Emulations

Number of resident/scalable typefaces

Supports PostNet/other bar codes

Cost per monochrome page

"Ink cartridge low" indicator

Color Capability

Color printing

Uses 3-color/4-color ink cartridges

Separate cartridges for each color

Pantone approval claimed

Cost per color page/percentage of color coverage per page

Driver provides default settings based on intelligent analysis of page

Driver allows user control of color

Customer support

Toll-free technical support/BBS

Telephone support hours (eastern time)

Warranty (parts and labor)

N/A—Not applicable. The product does not have this feature.

*This calculation is based on a 2,000-character page.

PC MAGAZINE
EDITORS' CHOICE

CalComp TechJet Personal	Canon BJ-100 Bubble Jet	Canon BJ-200e Bubble Jet	Canon BJC-600 Bubble Jet	Canon BJC-4000 Bubble Jet	Citizen Projet II
\$699	\$249	\$299	\$579	\$549	\$299
7.9 x 16.9 x 8.2	6.8 x 13.7 x 7.6	6.8 x 13.7 x 7.6	6.8 x 13.7 x 7.6	7.3 x 14.4 x 8.1	5.5 x 14.5 x 13.5
7.7	6.6	6.8	9.9	7.9	8.8
54	64	64	256 (same for color)	128 (136 for color)	50
360 x 360	360 x 360	360 x 360	360 x 360	360 x 360	300 x 300
■ □	■ □	■ □	■ □	■ □	■ □
Bundled	Bundled	Bundled	Bundled	Bundled	Bundled
11.7	11	11	11	11	8.5
24	28	28	28	28	27
□ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	□ ■	□ ■	□ ■	□ ■	□ ■
■ □	□ □	■ □	■ □	■ □	□ □
Rear U	Rear L	Rear L	Rear L	Rear L	Rear L
■	■	■	■	■	■
Canon BJ-10, Epson LQ series, HPGL, IBM Proprinter X24E	Epson LQ 2550, IBM Graphics Printer, IBM Proprinter X24E	Canon BJC-600, Epson LQ 2550, IBM Graphics Printer, IBM Proprinter X24E	Canon BJC-4000, Epson LQ 2550, IBM Graphics Printer, IBM Proprinter X24E	Epson LQ 2550, IBM Proprinter X24E	HP DeskJet Plus
7, 36	8, None	7, 7	27, 20	27, 20	13, None
□ □	■ ■	■ ■	■ ■	■ ■	□ □
12¢	8¢	8¢	2.9¢	4¢	3.2¢
□	□	□	■	■	■
□	□	□	■	■	□
N/A	N/A	N/A	□ ■	□ ■	N/A
N/A	N/A	N/A	■	□	N/A
N/A	N/A	N/A	□	□	N/A
N/A	N/A	N/A	7¢/10 percent	26¢/30 percent	N/A
N/A	N/A	N/A	□	□	N/A
N/A	N/A	N/A	■	■	N/A
■ ■	■ ■	■ ■	■ ■	■ ■	□ ■
8:00-8:00 M-F	8:00 A.M.-11:00 P.M. M-F	8:00 A.M.-11:00 P.M. M-F	8:00 A.M.-11:00 P.M. M-F	8:00 A.M.-11:00 P.M. M-F	11:00-7:00 M-F
1 year	2 years (limited)	2 years	2 years	2 years	2 years

output from most of the thermal wax transfer printers we review in the section on high-end color printers, with good coverage and color range and no banding.

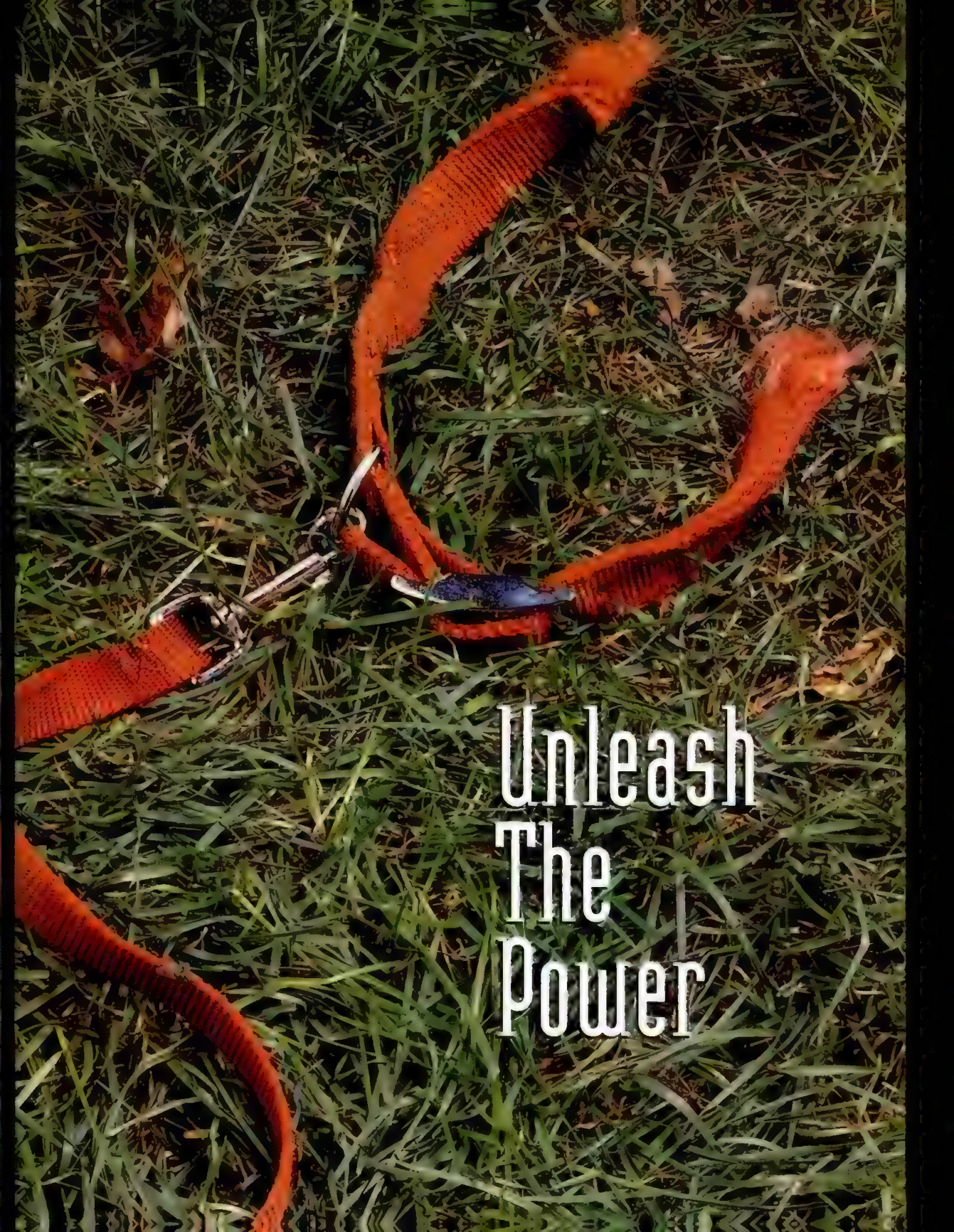
If you need multiuser support and print a lot of text, but also need color with a low consumables cost, the 1200C is a good bet. If you also need PostScript, go for the 1200C/PS. HP JetDirect network interface cards are optional (\$449 for Ethernet, \$699 for Token-Ring). Text speed throughput equaling 128 cps (7 pages per

minute) and color graphics speed of 0.7 gppm topped all other ink jets, and cost per page is among the lowest of the group: 2 cents for monochrome and just 13 cents for color. Its only real drawback is poor envelope handling (manual feed only, and the printer tends to eat the corner).

The 6-pound DeskJet 320 (\$379 list) replaces the Editors' Choice-winning DeskJet 310 (for more information, see *PC Magazine*, August 1994) and provides monochrome or three-color printing for

road warriors. You can feed pages manually or opt for the 60-sheet feeder (\$99). With monochrome throughput of 70 cps and 0.7 gppm (0.4 gppm for color), performance is good for a portable unit. Print quality is good, resembling that of the 540, and the costs per page are identical to those of the 540.

► **HP DeskJet 320.** List price: \$379; color kit, \$49; cut-sheet feeder, \$99; battery, \$49. **HP DeskJet 540.** List price: \$365; color kit, \$49. **HP DeskJet 560C.** List price:

A red fire hose with a silver nozzle is coiled on a patch of green grass. The hose is the primary subject, with its bright red color contrasting against the green grass. The nozzle is silver and has a black handle. The text 'Unleash The Power' is overlaid in the bottom right corner in a white, serif font.

Unleash
The
Power

A cartoon illustration of a brown and white dog jumping joyfully against a background of soft, white clouds. A large thought bubble originates from the dog's head, containing promotional text.

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ColorBook DX4-75, PC World, August '94

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► SUMMARY OF FEATURES

CONTINUES

Ink Jets

In alphabetical order by company

■ = YES □ = NO

	C. Itoh ProWriter SpeedJet CJ-300 Lite	C. Itoh ProWriter SpeedJet CJ-300	DEC- colorwriter 520ic	Epson Stylus 400	Epson Stylus 800+	Epson Stylus 1000
List price (base configuration)	\$299	\$419	\$449	\$299	\$399	\$599
Dimensions (HWD in inches)	5.6 x 15.6 x 13	5.6 x 15.6 x 13	6.6 x 15.2 x 16	6.3 x 17 x 10.4	8 x 17 x 10.4	8 x 26 x 20
Weight (pounds)	12	12	11	10.6	10.6	19
Number of jets	128	128	50 (same for color)	48	48	48
Maximum resolution (dpi)	300 x 300	300 x 300	300 x 300	360 x 360	360 x 360	360 x 360
Parallel/serial port	■ □	■ Optional	■ ■	■ □	■ □	■ □
Printer-specific Windows 3.1 driver	Bundled	Bundled	Bundled	Bundled	In Windows 3.1	In Windows 3.1
Paper Handling						
Maximum paper width (inches)	9	9	8.5	8.5	8.5	16.5
Rated maximum paper weight (pounds)	24	24	24	24	24	24
Can print on card stock/transparencies	■ ■	■ ■	■ ■	□ ■	□ ■	□ ■
Can print on 8-size paper/envelopes	□ ■	□ ■	□ ■	□ ■	□ ■	■ ■
Pressure/tractor paper feed	■ □	■ □	■ ■	■ □	■ □	■ ■
Paper paths	Top L	Top L	Rear U, front L	Front L	Front L, top U	Front L
Landscape printing	■	■	■	■	■	■
Fonts and Features						
Emulations	HP DeskJet 500 series	HP DeskJet 500 series	Epson LQ series (optional), IBM Proprinter (optional)	Epson ESC P/2, Epson FX series, Epson LQ series	Epson ESC P/2, Epson LQ series	Epson ESC P/2, Epson LQ series
Number of resident/scalable typefaces	3, None	3, None	5, 2	8, 4	10, 6	10, 6
Supports PostNet/other bar codes	□ □	□ □	□ □	□ □	□ □	□ □
Cost per monochrome page	3¢	3¢	5¢	2.5¢	2.5¢	Info not available
"Ink cartridge low" indicator	□	□	■	■	■	■
Color Capability						
Color printing	□	□	■	□	□	□
Uses 3-color/4-color ink cartridges	N/A	N/A	■ □	N/A	N/A	N/A
Separate cartridges for each color	N/A	N/A	□	N/A	N/A	N/A
Pantone approval claimed	N/A	N/A	□	N/A	N/A	N/A
Cost per color page/percentage of color coverage per page	N/A	N/A	56¢/25 percent	N/A	N/A	N/A
Driver provides default settings based on intelligent analysis of page	N/A	N/A	■	N/A	N/A	N/A
Driver allows user control of color	N/A	N/A	■	N/A	N/A	N/A
Customer support						
Toll-free technical support/BBS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Telephone support hours (eastern time)	11:30-8:00 M-F	11:30-8:00 M-F	8:30-8:00 M-F	9:00-9:00 M-F	9:00-9:00 M-F	9:00-9:00 M-F
Warranty (parts and labor)	1 year	1 year	2 years	2 years	2 years (limited)	2 years (limited)

N/A—Not applicable; The product does not have this feature.

*This calculation is based on a 2,000-character page.

\$719; 256K RAM upgrade, \$175. **HP DeskJet 1200C/PS.** List price: \$2,428; 1MB SIMM, \$119; 2MB SIMM, \$209; 4MB SIMM, \$309; 8MB SIMM \$579; black print cartridge, \$29.95; color print cartridges, \$34.95 each; HP JetDirect network cards, \$449 for Ethernet, \$699 for Token-Ring. Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, MS511L-SJ, Santa Clara, CA 95051; 800-752-0900; fax, 800-333-1917.

Circle 450 on reader service card

Olivetti Office USA

• Olivetti JP 450

BY ELISABETH HOLZER

True to its name, Olivetti Office USA is going after the business user with its \$499 (\$399 to \$449 street) JP 450 color ink jet. The top of Olivetti's new ink jet line, the printer was indeed among the top performers on most of our tests. Output speed and quality make this midpriced

unit a worthy contender.

The JP 450 comes with a 150-sheet input tray standard and can handle an additional 150-sheet tray; a tractor feed is also an option. It offers 30 resident bitmapped fonts and 25 TrueType scalable fonts, plus PCMCIA slots for extra fonts and an optional serial interface. The easy-to-use control panel make setup and configuration a breeze.

Monochrome letter-quality text output was superior. Characters were dark.

SUMMARY OF FEATURES

ENDS

Ink Jets

PC MAGAZINE PC MAGAZINE PC MAGAZINE
BEST BUY BEST BUY BEST BUY

In alphabetical order by company

■ = YES □ = NO

List price (base configuration)

Dimensions (HWD in inches)

Weight (pounds)

Number of jets

Maximum resolution (dpi)

Parallel/serial port

Printer-specific Windows 3.1 driver

Paper Handling

Maximum paper width (inches)

Rated maximum paper weight (pounds)

Can print on card stock/transparencies

Can print on B-size paper/envelopes

Pressure/tractor paper feed

Paper paths

Landscape printing

Fonts and Features

Emulations

Number of resident/scalable typefaces

Supports PostNet/other bar codes

Cost per monochrome page

Ink cartridge low indicator

Color Capability

Color printing

Uses 3-color/4-color ink cartridges

Separate cartridges for each color

Pantone approval claimed

Cost per color page/percentage of color coverage per page

Driver provides default settings based on intelligent analysis of page

Driver allows user control of color

Customer support

Toll-free technical support/BBS

Telephone support hours (eastern time)

Warranty (parts and labor)

N/A—Not applicable. The product does not have this feature.

*This calculation is based on a 2,000-character page.

	Epson Stylus Color	HP DeskJet 320	HP DeskJet 540	HP DeskJet 500C	HP DeskJet 1200C/PS	Olivetti JP 450	TI microMark Color
List price (base configuration)	\$699	\$379	\$385	\$719	\$2,428	\$499	\$439
Dimensions (HWD in inches)	7.5 x 18.5 x 20.5	2.6 x 12.2 x 5.8	7.9 x 17.2 x 10	8.2 x 17.5 x 15.3	11.1 x 19.1 x 18.9	6.8 x 15.2 x 18.3	6.9 x 15.2 x 18.3
Weight (pounds)	16.3	4.3 (7.5 with feeder)	11.8	14.5	29	11	11
Number of jets	64 (48 for color)	54 (48 for color)	54 (48 for color)	54 (48 for color)	108 (416 for color)	50 (51 for color)	50 (51 for color)
Maximum resolution (dpi)	720 x 720	600 x 300	600 x 300	600 x 300	600 x 300	300 x 300	300 x 300
Parallel/serial port	■ ■	■ Optional	■ Optional	■ Optional	■ Optional	■ Optional	■ □
Printer-specific Windows 3.1 driver	Bundled	Bundled	Bundled	Bundled	Bundled	Bundled	Bundled
Maximum paper width (inches)	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Rated maximum paper weight (pounds)	24	24	36	36	36	36	24
Can print on card stock/transparencies	□ ■	■ ■	■ ■	■ ■	■ ■	■ ■	□ ■
Can print on B-size paper/envelopes	□ ■	□ ■	□ ■	□ ■	□ ■	□ ■	□ ■
Pressure/tractor paper feed	■ □	□ □	□ □	■ □	■ □	■ Optional	■ □
Paper paths	Front L	Bottom vertical	Front U	Front L	Front L	Front L, top U (optional)	Rear U, front L
Landscape printing	■	■	■	■	■	■	■
Emulations	Epson ESC P/2, Epson LQ series	HP DeskJet 300 series, IBM Proprinter	HP DeskJet 500 series, IBM Proprinter	HP DeskJet 500 series, IBM Proprinter	HP DeskJet 1200 series	Epson LQ series (optional), HP DeskJet 500 series, IBM Proprinter (optional)	HP DeskJet 500C
Number of resident/scalable typefaces	7, 4	4, 15	4, 4	8, 6	46, 46	30, 25	5, None
Supports PostNet/other bar codes	□ □	□ □	□ □	□ □	□ □	■ ■	□ □
Cost per monochrome page	2¢	3¢	3¢	3¢	2¢	3.3¢	9.6¢
Ink cartridge low indicator	■	■	□	□	□	■	□
Color printing	■	Optional	Optional	■	■	■	■
Uses 3-color/4-color ink cartridges	□ ■	■ □	■ □	□ ■	□ ■	■ □	■ □
Separate cartridges for each color	□	□	□	■	■	□	□
Pantone approval claimed	□	□	□	□	■	□	□
Cost per color page/percentage of color coverage per page	32¢/15 percent	21¢/25 percent	21¢/25 percent	21¢/25 percent	13¢/25 percent	32¢*/info not available	\$1.19/25 percent
Driver provides default settings based on intelligent analysis of page	■	■	■	■	■	■	■
Driver allows user control of color	■	■	■	■	■	■	■
Toll-free technical support/BBS	■ ■	□ ■	□ ■	□ ■	□ ■	■ □	■ ■
Telephone support hours (eastern time)	9:00–9:00 M–F	8:00 A.M.–11:00 P.M. M–F	8:00 A.M.–11:00 P.M. M–F	8:00 A.M.–11:00 P.M. M–F	8:00 A.M.–11:00 P.M. M–F	8:30–5:00 M–F	8:00–8:00 M–F
Warranty (parts and labor)	2 years (limited)	1 year (exchange)	3 years	3 years	3 years	1 year	1 year

well formed, and crisp, with no bleeding. Gray-scale graphics (300 by 300 dots per inch) were also admirable, with good detail and just some banding. The vivid color output showed no smearing or bleeding, though when the three-color cartridge is in use, black is a composite black. We noticed some color shadows around black text printed in color mode. Output quality doesn't come at the price of speed: The JP 450 delivered 107 characters per second and 3.5 graphics pages per minute,



near the top of all ink jets tested, including more expensive units. Reported cost per page is on a par with that of other ink jets.

The JP 450 represents the top of Olivetti's new ink jet line, which also includes the portable monochrome JP 50 (for more information, see *PC Magazine*, August 1994) and the graphics-optimized color JP 360 (\$399).

As we went to press we learned that Olivetti would not be shipping significant quantities of the JP 450 to end users

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until sometime in early 1995.

► **Olivetti JP 450.** List price: \$499; 150-sheet feeder, \$129; tractor feed, \$39.99, serial interface, \$49.99. Olivetti Office USA, P.O. Box 6945, Bridgewater, NJ 08807-0945; 908-526-8200; fax, 908-526-8405.

Circle 451 on reader service card

Texas Instruments Inc.

• TI microMarc Color

BY ELISABETH HOLZER

Texas Instruments now offers a color sibling to the TI microMarc we reviewed last year (November 23, 1993). The TI microMarc Color offers the same quick printing as the older unit, now with improved text output and color capability. The microMarc has been optimized for text output and desktop publishing, and its \$439 price tag (\$399 street) puts it within easy reach of the small-office/home-office segment. Be warned, though: Unlike the monochrome-only unit, printing costs per page are very high. A black-and-white page runs 9.6 cents—double the average for ink jets—and color will set you back a whop-

ping \$1.19 at 25 percent coverage, by far the highest color page cost of the printers reviewed in this section.

Installation is simple, and we found operation straightforward. The print cartridges (either black or three-color) pop in and out for easy switching between monochrome and color printing, and the built-in 100-sheet feeder worked flawlessly with the paper guides in place.

TI has designed the microMarc for word processors and low-end desktop publishers, and it shows. Monochrome letter-quality text output (600- by 300-dpi resolution for resident fonts, 300 by 300 dpi for

TrueType fonts and graphics) is crisp and dark, with no blurring or bleeding. Monochrome speed is a quick 106 characters per second and 3.3 graphics pages per minute—very fast for a unit in this price range, and among the fastest overall. Gray-scale graphics images did show some banding, however, and as with last year's unit, long vertical lines tended to become misaligned. With the three-color cartridge, composite black was dark, but did show some color shadows. Color graphics, produced at a more sluggish 0.4 gppm, were well saturated with no banding.

With above-average performance for a below-average price, the microMarc Color would seem a solid buy, comparing favorably with more expensive printers. Those costs per page scare us, though. □

► **TI microMarc Color.** List price: \$439; black print cartridge, \$22; monochrome printhead, \$29; color printhead, \$38. Texas Instruments Inc., P.O. Box 149149, Austin, TX 78714-9149; 800-848-3927; fax, 512-250-7329.

Circle 452 on reader service card



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*Official 1993 Monitrak U.S. monitor sales research

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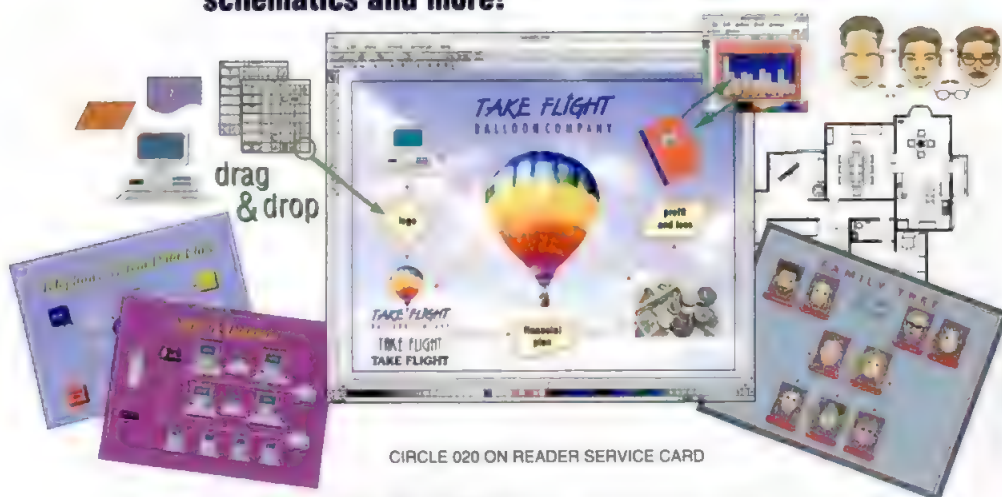
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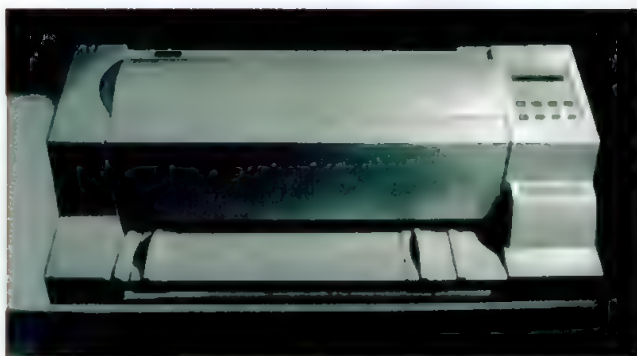
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Dot matrix printers are losing market share to low-cost ink jets. But for high-volume printing, printing multipart forms, or simply churning out the cheapest output possible, one of these 29 printers should fill the bill.

Fading

By Bruce Brown

Dot matrix printers won't disappear, but they are quickly being squeezed out of the home and home-office markets by ink jet printers, which offer quieter operation and superior output for street prices as low as \$249 (\$379 for color). BIS Strategic Decisions, a market research firm based in Norwood, Massachusetts, predicts an ongoing decline of dot matrix sales in the U.S. and foresees dot matrix sales of a little under 3.5 million in 1994, or 30 percent of total printer sales. This compares with 4.6 million sold in 1993, or 42 percent of total printer sales.

BIS reports that most dot matrix printers being sold today are no-frills products purchased either as part of entry-level computer-system bundles or by budget-conscious consumers who demand only legibility from their printers. Indeed, of the 29 impact printers we found this year, 13 have list prices under \$330. This compares with 6 out of 35 last year. By the same token, only 7 are priced between \$330 and \$1,000,

Impact



► IN THIS REVIEW

<i>Advanced Matrix AMT Accel-535dsi</i>290	<i>Fujitsu DL 1150</i>300
<i>Alps DMX 180</i>290	<i>Fujitsu DL 1250</i>300
<i>Citizen GSX-220</i>291	<i>Fujitsu DL 3800</i>300
<i>C. Itoh ProWriter C-410</i>294	<i>Fujitsu DL 6400</i>300
<i>C. Itoh ProWriter C-415</i>294	<i>Genicom 3840EM</i>301
<i>C. Itoh ProWriter C-420</i>294	<i>Genicom 3940IP</i>301
<i>C. Itoh ProWriter C-425</i>294	<i>Genicom 4840</i>301
<i>C. Itoh ProWriter</i>	<i>Mannesmann Tally T6082</i>301
<i>C-610III Multifunction Printer</i>294	<i>Panasonic KX-P1150</i>301
<i>DECwriter 65</i>291	<i>Panasonic KX-P2135</i>301
<i>Digital LA600 MultiPrinter</i>291	<i>Samsung SP-0912</i>304
<i>Epson LX-300</i>297	<i>Samsung SP-2412</i>304
<i>Epson ActionPrinter 3260</i>297	<i>Samsung SP-2417</i>304
<i>Epson ActionPrinter 5000+</i>297	<i>Star Micronics NX-2450 Rainbow</i>304
<i>Epson DFX-5000+</i>297	<i>Star Micronics NX-2480 Rainbow</i>304

compared with 21 last year. Nine printers fall into the over-\$1,000, high-speed, high-volume category, but BIS feels that this market is declining also, with most such printers being sold as replacement units in environments where that type of printer is entrenched. Corporate e-mail now obviates the need to print out the numerous memos and reports that used to be the mainstay of high-volume impact printers.

Yet a dot matrix unit is still your best bet for certain niche applications that don't require quality output. Besides having the lowest prices (\$120 for the Samsung SP-0912), these printers offer the cheapest printing imaginable (less than 1 cent per page). They also represent the cheapest solution for B-size output and color. Dot matrix units also require minimal maintenance.

Dot matrix printers still dominate the arena of multipart-form printing, which no other existing technology can handle. Of the 29 printers here, 27 come standard with some support for multipart forms, and 8 can print on six or more layers of forms at a time. The AMT Accel-535dsi is king here, with the ability to print on up to 12 layers of forms.

REVIEW CRITERIA

To be included in this year's printer roundup, a dot matrix printer had to be a new model available in distribution channels by August 15, 1994. We received our 29 printers from 12 manufacturers. Data-south Computer Corp.'s Datasouth Documax (price not yet set) did not arrive in time for testing, and Tandy/Radio Shack Corp. announced a new dot matrix

printer, the Tandy DMP 207 (\$299.99), as we were going to press.

We tested each printer's raw text and graphics print speeds and ran our suite of Windows applications tests. These involve the printing of typical business documents from popular Windows apps.

As expected, budget printers (below

\$330 list) showed the slowest text-printing speeds, printing letter-quality text at an average speed of 41 characters per second. Speeds ranged from 26 cps for the 9-pin Panasonic KX-P1150 to 56 cps for the 24-pin Star Micronics NX-2480 Rainbow (\$329). Draft-text print speeds ranged from 53 cps for the 24-pin Epson ActionPrinter 3260 (\$299) to 119 cps for the Star Micronics NX-2480 Rainbow, averaging 85 cps.

Midprice printers (\$330 to \$1,000) fared slightly better, averaging 52 cps for printing letter-quality text. Speeds ranged from 39 cps for the 9-pin C. Itoh ProWriter C-410 (\$399) and C. Itoh ProWriter C-415 (\$499) to 82 cps for the Fujitsu DL 3800 (\$829). Draft-text print speeds ranged from 92 cps for the C. Itoh ProWriter C-420 (\$499) to 154 cps for the Fujitsu DL 3800, averaging 117 cps.

Of the high-price printers, letter-quality-text print speeds averaged 88 cps, ranging from a slow 51 cps for the C. Itoh

HIGHLIGHTS

Dot Matrix Printers

ARE DOTS DYING? The markets traditionally served by dot matrix printers are being taken over by new technologies, and each passing year sees a decline in market share for impact printers. But for individuals concerned with cost, and for printing multipart forms, dot matrix and line printers are your best bets. No dot matrix printer, however, produces color nearly as well as the most mediocre ink jet printer.

AT THE LOW END, affordable, quiet ink jet printers are giving dot matrix units a run for their money, but dot matrix printers still offer the cheapest alternative. The Panasonic KX-P1150, for example, produces perfectly legible documents and lists for just \$169.95.

FOR BUSINESS USERS, a good dot matrix printer can provide clean, sharp text at a negligible cost (less than a penny per page, which compares favorably with per-page costs

of about 3 cents for an ink jet). We especially liked the Epson ActionPrinter 5000+ (\$249 street). Nearly all the printers here can print through multipart forms, and the AMT Accel-535dsi can punch through forms 12 layers thick.

HIGH SPEED, HIGH VOLUME is the specialty of line printers and the more expensive dot matrix units. For churning out mass mailings and the like reliably and affordably, nothing compares with these workhorses. The Fujitsu DL 6400 topped the dot matrix field for speed in letter-quality mode, managing 116 cps. At 298 cps, the Epson DFX-5000+ led the pack in draft mode. Need more speed? Check out a line printer. The Mannesmann Tally T6082 isn't cheap (it costs about \$8,000 on the street), but it hums along at 272 lines per minute (lpm) in quality mode and 457 lpm in draft mode—equivalent to 15 pages per minute.

ProWriter C-610III to a blazing 116 cps for the Fujitsu DL 6400 (\$1,595). Draft-text print speeds ranged from 186 cps for the AMT Accel-535dsi (\$2,495) to 298 cps for the Epson DFX-5000+ (\$1,899), averaging 222 cps.

Of the two line printers we looked at, the Mannesmann Tally T6082 (\$8,799) fared best, with 272 lines per minute in letter-quality mode and 457 lpm in draft mode.

Graphics print speeds did not follow price categories, since higher-end printers are primarily aimed at printing text. Speeds averaged 0.9 graphics pages per minute, with the slowest unit being the Alps DMX 180 (\$229) at 0.5 gppm and the fastest being the Fujitsu DL 6400 at 2.2 gppm.

PATHS AND TRACTORS

Many of the features that dot matrix printer manufacturers once used to compete against one another have now become largely irrelevant. Today, TrueType and Adobe Type Manager provide any user with high-quality scalable fonts. Only eight of the printers reviewed here provide scalable fonts of their own. Quiet modes? If you want quiet printing, buy an ink jet printer. Only nine dot matrix printers here offer them. Also, 24 pins have become standard for the home-office printer, with only three 9-pin printers here selling for less than \$330.

Besides speed and print quality, the other major feature differentiating low-end and high-end dot matrix printers is color, offered standard or as an option in 9 of the 13 printers priced under \$330. Of these, the two from Star Micronics America offer the best color output. The Samsung SP-2417 (\$299) offers the worst.

The mid- and high-price printers tend to offer more rugged construction, faster speeds, and more paper paths, with paper parking for easily switching among cut-sheet paper, fanfold, multipart forms, and even envelopes. The Epson ActionPrinter 5000+, Digital LA600 MultiPrinter (\$2,999), and Genicom 3840EM (\$2,595) lead the pack with four paper paths each. At the high end, the AMT Accel-535dsi, Genicom 3840EM, Genicom 3940IP (\$3,795), Fujitsu DL 6400, and Mannesmann Tally T6082 even offer multiple tractors for loading and switching be-



Personal/small-business printer:

• Epson ActionPrinter 5000+

Departmental printer:

• Fujitsu DL 6400

As ink jet and laser printers come down in price, the traditional entry-level niche of dot matrix printers has been all but taken over. But dot matrix and

line printers are appropriate for other tasks, such as printing multipart forms and high-volume, high-speed printing.

At the low-cost end of this category (below \$330 list), there were several adequate models to choose from, but none that we felt deserved an Editor's Choice nod. Every one we looked at suffered from painfully slow throughput, dotty text, paper-feeding problems, or flimsy construction.

From among the midprice units, we chose—for the second year in a row—the Epson ActionPrinter 5000+ (\$349 list, \$249 street), which is also sold as the Epson LQ-570+. Letter-quality text from this unit was dark and sharp, and gray-scale graphics were among the best we saw from a 24-pin dot matrix unit. The Epson ActionPrinter 5000+ managed above-average speed, and the printer offers four paper paths, making it a good choice for individuals and small businesses.

We looked at several dot matrix printers aimed at high-volume departmental printing. All offer the speed and ruggedness needed to churn out form letters and multipart forms day in and day out, but we liked the Fujitsu DL

6400 the best. Text was crisp and well formed in both draft and quality modes, and built-in commands let you print bar codes. The straight paper path minimizes jams. Its throughput speed of 116 cps in quality mode was the quickest of the 24-pin units tested, and at \$1,180 on the street, the Fujitsu printer costs about \$1,000 less than competing printers.

A few other dot matrix printers deserve special note. Advanced Matrix Technology's AMT Accel-535dsi (\$1,995 street) prints legibly on multipart forms up to 12 layers thick. The C. Itoh ProWriter C-610III Multifunction Printer (\$999 street) provides a front-feed slot that accepts bank books.

Corporations in the market for a super-duty line printer would do well with either of the two line printers we tested, the Genicom 4840 (\$7,495) or the Mannesmann Tally T6082 (\$8,000 street). The Mannesmann Tally unit was faster at producing text under DOS—it managed 272 lines per minute in quality mode and 457 lpm (equivalent to 15 pages per minute) in draft mode—but the Genicom printer was quicker on all three of our Windows applications tests.

tween multiple sets of forms.

Bar code printing is offered by ten of the printers reviewed here, with seven (including the low-cost \$229 DECwriter 65) offering support for Postnet bar codes.

A new feature found in high-end printers—offered here by five of the dot matrix units and both of the line printers—is an optional network interface for department-wide shareability.

The two line printers profiled here, the Genicom 4840 and Mannesmann Tally

T6082, top the dot matrix entries in terms of speed, but they are also much more expensive. They feature the same paper-handling and other hard-duty features of the workhorse dot matrix printers, but they are huge floor-standing units built to run fast and long.

Finally, if you need to print on bank books or other thick materials not normally taken by printers, check out the C. Itoh ProWriter C-610III, which can accept thick items fed through the front.

Dot matrix printers range from inexpensive units targeted at the home and student markets to high-ticket, high-output workhorses aimed at large corporations. Output speeds vary accordingly.

What the Numbers Mean

Letter-quality Text Speed test results showed little correlation to the number of pins in the printhead, as the top three performers were from both the 18- and 24-pin categories. The fastest printer was the 24-pin Fujitsu DL 6400 at 116 characters per second, but trailing close behind were the 18-pin Genicom 3940IP (107 cps) and Genicom 3840EM (105 cps). The slowest printers in letter-quality mode were the 9-pin Panasonic KX-P1150 at 26 cps and the 24-pin Alps DMX 180 at 28 cps. The Alps unit, in particular, was hampered by four-pass printing: Each line of print required four passes of the printhead. Graphics performance for all of these printers was about average, with the Fujitsu printer again being the fastest at 2.2 graphics pages per minute and the Alps unit the slowest at 0.5 gppm.

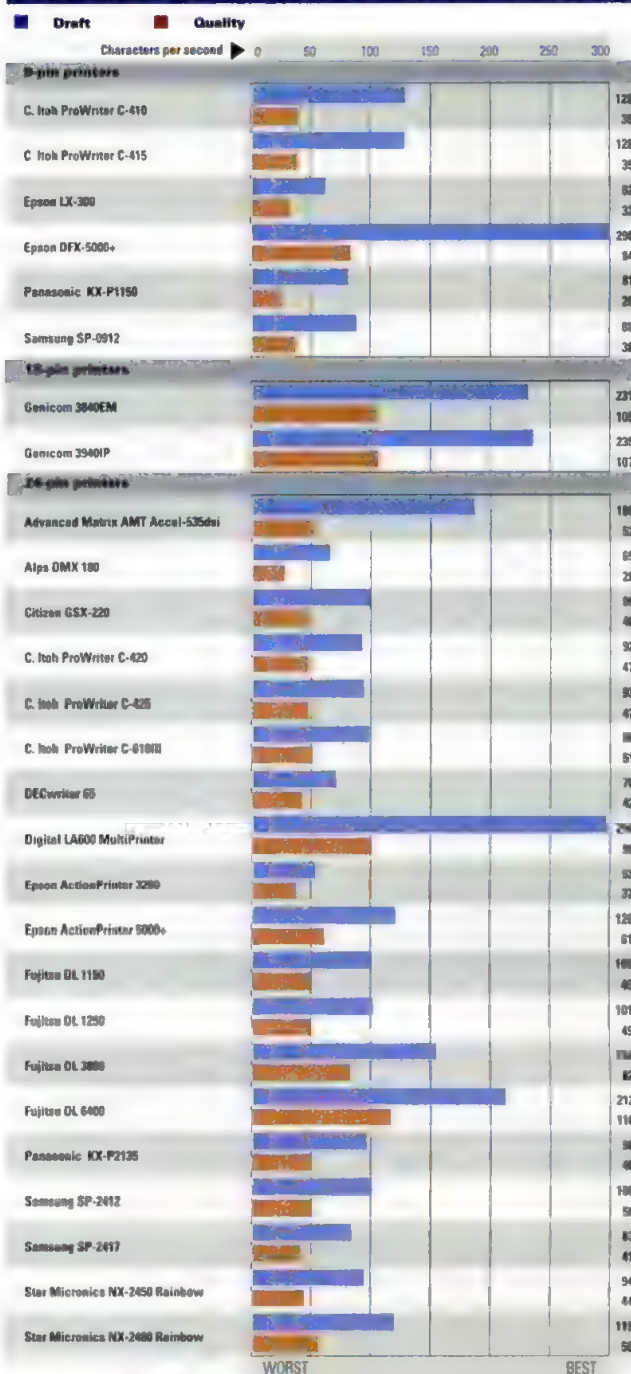
For draft-mode printing, the rule of thumb holds that a printer whose draft print speed is twice its quality print speed is performing well. Here, nearly all of the printers managed respectable speeds. The fastest, the Epson DFX-5000+ (289 cps) and Digital LA600 MultiPrinter (296 cps), had draft print speeds triple that of their letter-quality print speeds. Bringing up the rear was the Epson ActionPrinter 3260, at 53 cps.

Windows applications tests are principally a test of a printer's driver, and results here are typically slower than what we saw on our DOS tests. The fastest printer on the Microsoft Word for Windows, Lotus 1-2-3, and CorelDRAW tests was the Genicom 3840EM, with speeds of 109 cps, 1.3 gppm, and 2.7 gppm, respectively. The slowest in text output was the AMT Accel-535dsi, at a woeful 14 cps. We suspect that the Digital LA600 MultiPrinter and Fujitsu DL 6400, which provided the best performance under DOS, suffer from poor or inadequate Windows drivers.

LINE PRINTERS

The Mannesmann Tally T6082 was the clear winner on our Text Speed test, at 272 lines per minute in letter-quality mode. Our only other line printer, the Genicom 4840, achieved 170 lpm, though the margin wasn't as great between their draft speeds. Graphics printing was nearly equal for both printers: 1.9 gppm for the Mannesmann Tally unit and 2.1 gppm for the Genicom unit. On our Windows applications tests, the Genicom unit benefited from a proprietary Windows driver and provided superior performance. On our Word for Windows, Lotus 1-2-3, and CorelDRAW tests, the Genicom printer managed rates of 112 lpm, 2.1 gppm, and 2.1 gppm, respectively. This compared with 76 lpm, 0.8 gppm, and 1.2 gppm for its competitor.

TEXT SPEED (NARROW CARRIAGE)



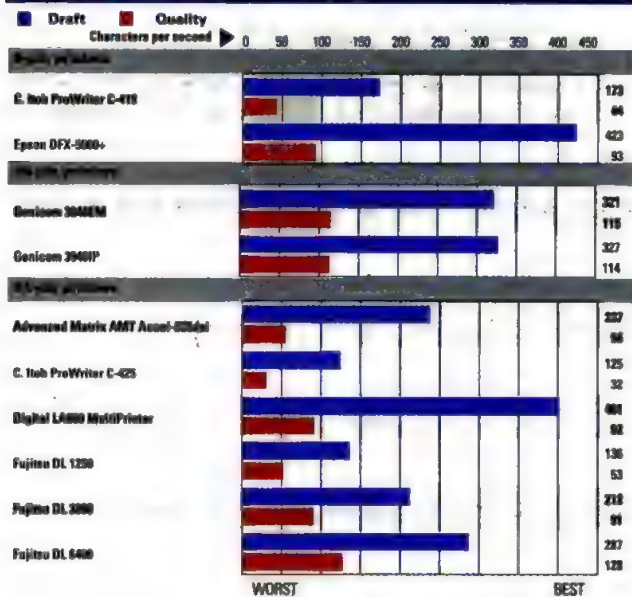
How We Tested

TEST CATEGORIES

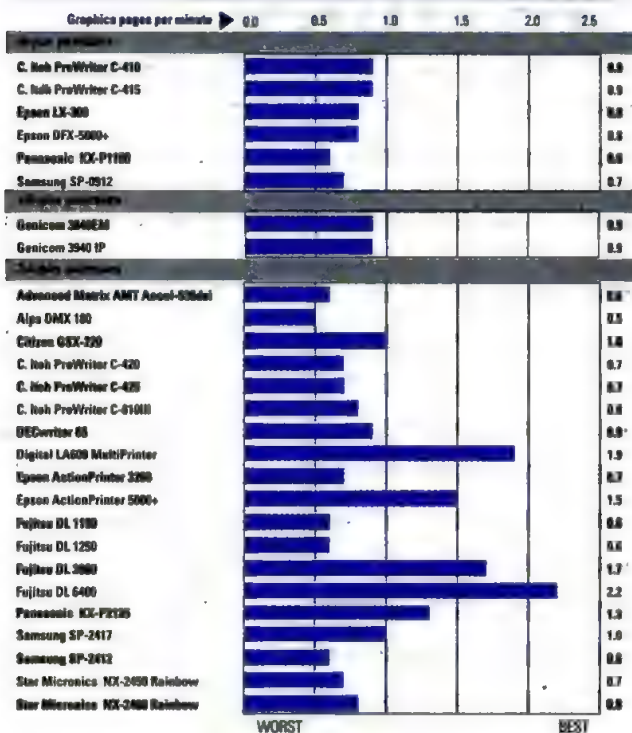
The **Text Speed** test measures the printer's speed in producing one copy of a two-page business letter with 1-inch margins in 10-cpi type. We ran the test twice, once in draft mode and once in quality mode.

The **Graphics Speed** test measures the printer's speed in producing two copies of a complex single-page graphic containing a TIFF image, horizontal

TEXT SPEED (WIDE CARRIAGE)



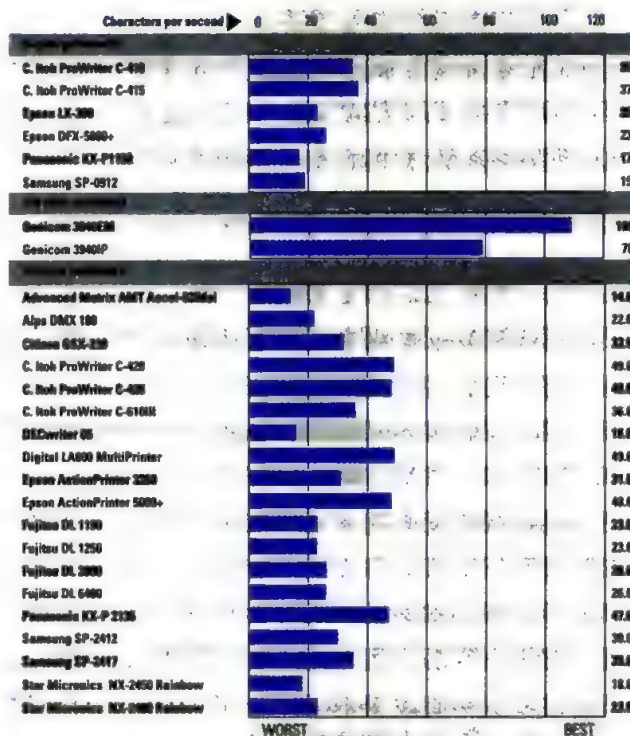
GRAPHICS SPEED



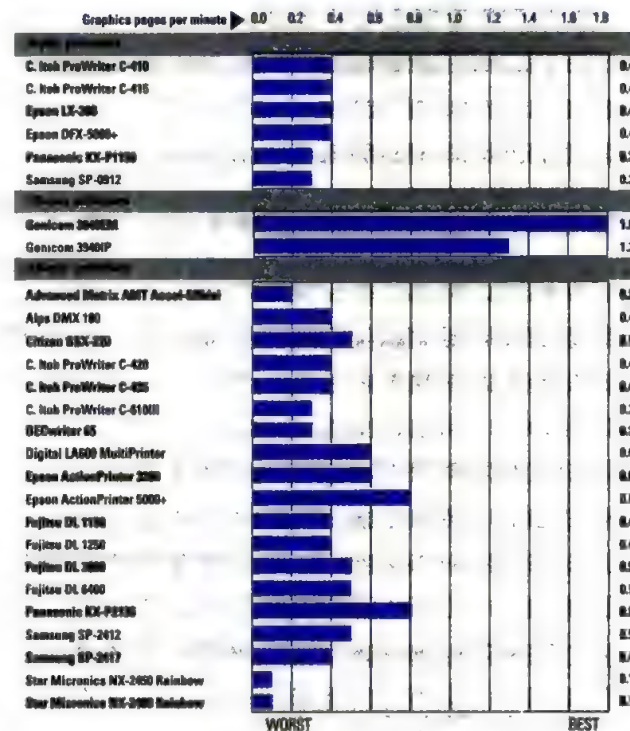
and vertical gray scales, and line art. A print file is sent directly to the printer from DOS.

The **Word for Windows** test measures the printer's speed in producing a two-page report that uses multiple fonts and type styles. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

WORD FOR WINDOWS



LOTUS 1-2-3 FOR WINDOWS



The **Lotus 1-2-3 for Windows** test measures the printer's speed in producing a complex two-page spreadsheet that contains pie, bar, and line charts. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

The **CorelDRAW** test measures the printer's speed in producing a single-page CorelDRAW graphic that contains a TIFF image, horizontal and vertical gray scales, and line art. We tested each printer with the Microsoft Windows driver recommended by the printer's manufacturer.

TEXT SPEED (NARROW CARRIAGE)



TEXT SPEED (WIDE CARRIAGE)



GRAPHICS SPEED



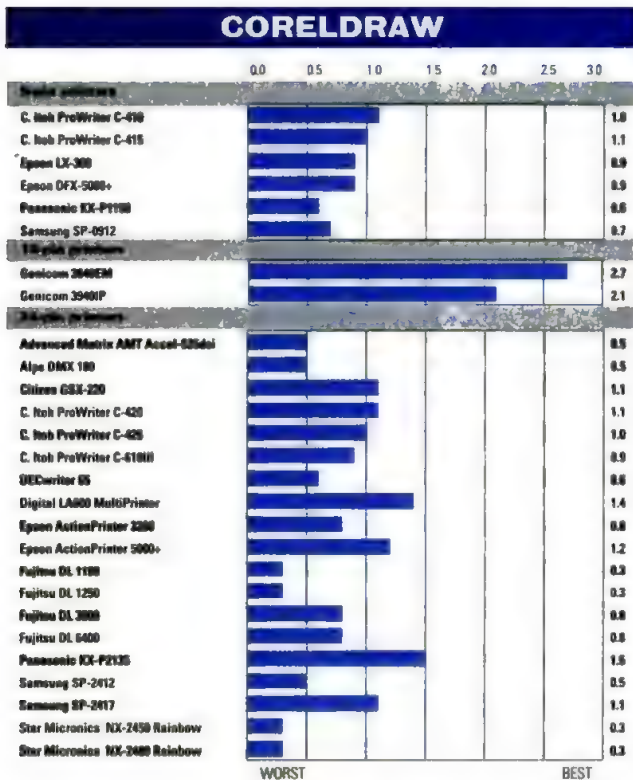
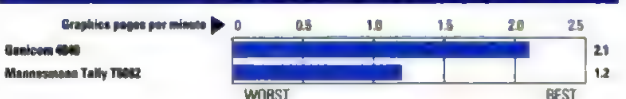
WORD FOR WINDOWS



LOTUS 1-2-3 FOR WINDOWS



CORELDRAW



Dot matrix may be on its way out, but you can still find a variety of models at all price levels to fit your particular needs.

Advanced Matrix Technology Inc.

• AMT Accel-535dsi

BY BILL DYSZEL

Intended particularly for the task of printing on heavyweight multipart forms, the \$2,495 (\$1,995 street) AMT Accel-535dsi from Advanced Matrix Technology (800-992-2264) can provide legible printing on multipart forms of up to 12 layers.

The Accel-535dsi is loaded with extra features for easy operation. You can have two sources of tractor-fed paper loaded at

once and switch between them with the flip of a lever. The paper tear-off is just below the last printed line, eliminating waste. A dial on the control panel gives quick access to programmable settings and permits fine-grade adjustment of the paper and print head, which helps when aligning preprinted forms. The Accel-535dsi can handle tractor-fed media or cut sheets (including forms, labels, card stock, and transparencies) of up to 17 inches wide.

In draft mode, the 24-pin Accel-535dsi topped out at 186 cps—among the fastest text-printing speeds clocked by a 24-pin printer. Print quality here was legible, though characters were not particularly

well formed. Letter-quality text-printing speed was about average at 52 cps, and quality here was better (though at smaller type sizes, the open spaces in letters tended to close up). Gray-scale graphics, which the Accel-535dsi can produce at a moderate 0.6 gppm, retained good detail for a dot matrix unit.

Alps Electric Inc.

• Alps DMX 180

BY BILL DYSZEL

The newest entry from Alps Electric (408-432-6000), the Alps DMX 180, is one of the least expensive 24-pin dot matrix printers in our roundup: \$229 list, \$199 street. Alps has economized by offering

► SUMMARY OF FEATURES

CONTINUES

Dot Matrix Printers

In alphabetical order by company

■ = YES □ = NO

	Advanced Matrix AMT Accel-535dsi	Alps DMX 180	Citizen GSX-220	C. Itoh ProWriter C-410	C. Itoh ProWriter C-415	C. Itoh ProWriter C-420	C. Itoh ProWriter C-425
List price (base configuration)	\$2,495.00	\$229.00	\$199.00	\$399.00	\$499.00	\$499.00	\$599.00
Dimensions (HWD, in inches)	12 x 24 x 19	4.7 x 15.4 x 9.3	6.6 x 15.2 x 7.7	5.2 x 16.8 x 12.4	5.2 x 22.4 x 12.4	5.2 x 16.8 x 12.4	5.2 x 22.4 x 12.4
Weight (pounds)	57.0	7.1	8.8	14.4	17.7	14.4	17.7
Printer type	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix
Carriage size/Number of pins or hammers	Wide/24	Narrow/24	Narrow/24	Narrow/9	Wide/9	Narrow/24	Wide/24
Parallel/serial port	■ ■	■ □	■ □	■ Optional	■ Optional	■ Optional	■ Optional
Rated noise level in standard/quiet mode (dB)	55, N/A①	N/A①, N/A①	48, N/A①	55, 53	55, 53	55, 53	55, 53
Paper Handling							
Rated maximum paper weight (pounds)	24	20	27	21	21	21	21
Supports multipart forms	■	■	Optional	■	■	■	■
Number/thickness of multipart forms (inches)	12, 0.04	2, 0.15	3, 0.08	4, 0.01	4, 0.01	4, 0.01	4, 0.01
Paper paths	Front S, bottom vertical, rear L	Rear U, front L, rear L	Top U, rear L (optional)	Bottom vertical, rear L	Bottom vertical, rear L	Bottom vertical, rear L	Bottom vertical, rear L
Fonts and Features							
Emulations	Epson LQ series, IBM Proprinter	Epson LQ series	Epson LQ series, IBM Proprinter	Epson FX series, IBM Proprinter	Epson FX series, IBM Proprinter	Epson LQ series, IBM Proprinter	Epson LQ series, IBM Proprinter
Total number of fonts/scalable fonts	4, None	18, None	5, 2	5, None	5, None	7, None	7, None
Supports PostNet/other bar codes	Optional Optional	□ □	□ □	□ □	□ □	□ □	□ □
Prints in landscape mode/color	■ ■	□ □	■ Optional	□ □	□ □	□ □	□ □
Customer Support							
Toll-free technical support	■	■	□	■	■	■	■
Telephone support hours (eastern time)	10:00-7:30 M-F	11:30-8:00 M-F	11:00-7:00 M-F	11:30-8:00 M-F	11:30-8:00 M-F	11:30-8:00 M-F	11:30-8:00 M-F
BBS or on-line service	□	□	■	■	■	■	■
Warranty (parts and labor)	1 year	2 years	2 years	2 years	2 years	2 years	2 years
Reader service card number	455	456	457	458	458	458	458

N/A ①—Not applicable: The product does not have this feature

virtually no options, but for home users, students, and small businesses with simple needs, the DMX 180 should suffice.

The printer has only one emulation, Epson LQ, and no other expansion options. It is lightweight and compact, but not at all flimsy. Paper can be fed either in single sheets or through the rear push-tractor feed mechanism. Setup is easy, as there are very few choices to make.

Print quality from the 360- by 360-dpi unit was satisfactory in letter-quality mode, with dark, well-formed letters in the resident roman and sans serif fonts. Text printed in draft mode was legible, but reading long documents might become uncomfortable. Gray-scale graphics had some expected jaggedness and loss of detail, but they looked better overall than much of the other dot matrix output we saw.

The DMX 180 is one of the slowest units we tested: 28 cps in letter-quality

mode. Draft-text print speed picked up to 65 cps, and there is a super draft speed, rated at 180 cps. Graphics printing was also on the slow side at 0.5 gppm.

Citizen America Corp.

• **Citizen GSX-220**

Digital Equipment Corp.

• **DECwriter 65 • Digital LA600 MultiPrinter**

BY HOWARD ALEXANDER

The Citizen GSX-220 (\$199 list, \$175 street) from Citizen America Corp. (310-453-0614) and its Digital Equipment Corp. (800-777-4343) sibling, the DECwriter 65 (\$229 list, \$195 street), are inexpensive 24-pin dot matrix printers designed primarily for the individual or small-office/home-office user. The DECwriter 65 comes equipped with a color kit, as does the new Citizen GSX-220C (\$199), which was announced at press time. The printers are not the most solid units, but they do have adequate features

and speed for low-end models. For high-volume networked office applications, look at the Digital LA600 MultiPrinter, a high-speed, high-ticket (\$2,999 list, \$2,750 street) 24-pin monochrome printer.

The GSX-220 and DECwriter each come with Windows drivers and five resident typefaces, two of which are scalable. Their built-in 50-sheet feeders work well for the most part, though each has a tendency to take multiple sheets when only a few are left. For continuous paper, the optional push tractor (\$29) works better than the friction feed.

Setting up the printers proved to be simplicity itself. Configuration is handled through the three front-panel membrane switches and a status printout; there are no DIP switches to set. Power and input connectors are on the side rather than the back of each unit, which may be obtrusive for some installations.

The GSX-220 proved to be the faster

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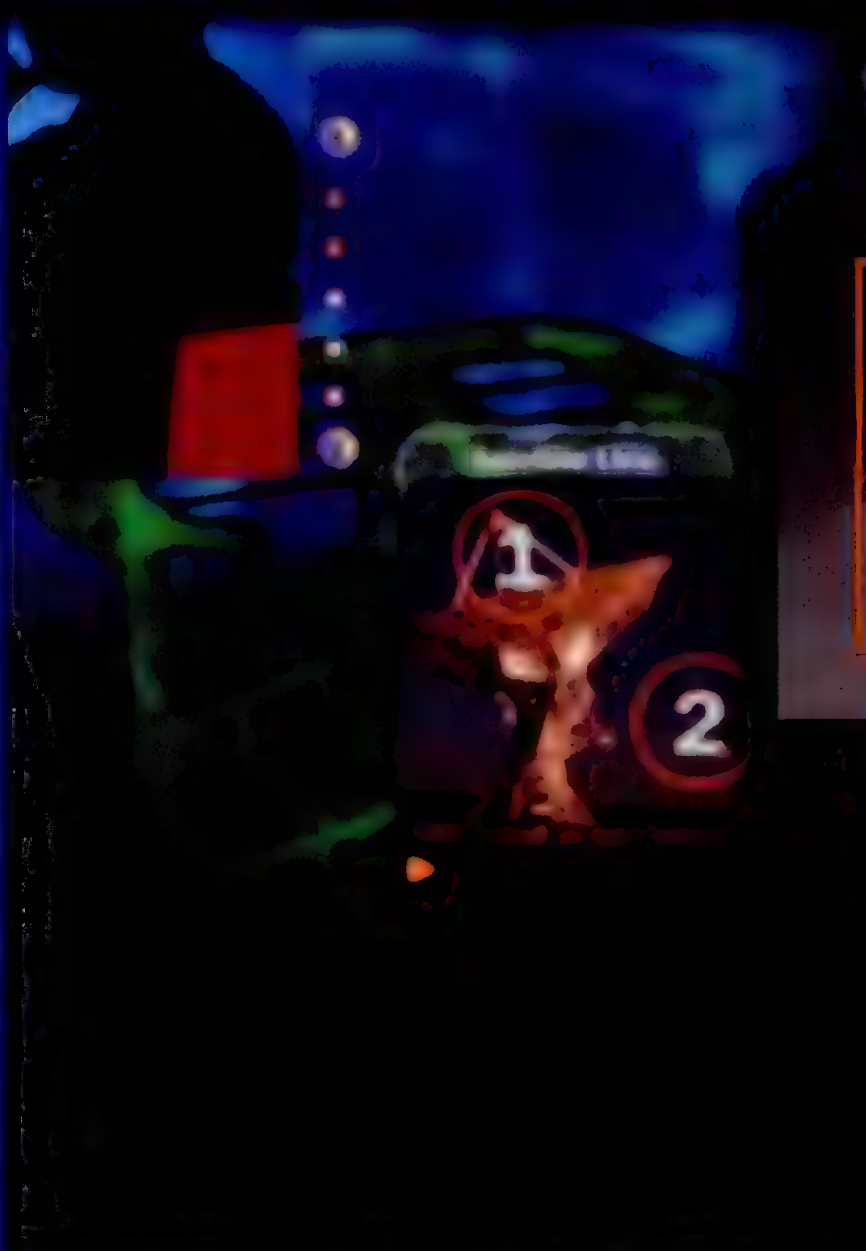


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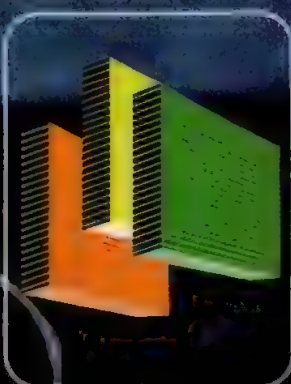
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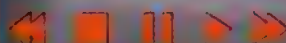
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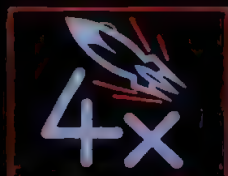
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► SUMMARY OF FEATURES

CONTINUES

Dot Matrix Printers

PC MAGAZINE
EDITORS' CHOICE

In alphabetical order by company

■ = YES □ = NO

	C. Itoh ProWriter C-610III Multifunction Printer	DECwriter 65	Digital LA600 MultiPrinter	Epson LX-300	Epson ActionPrinter 3260	Epson ActionPrinter 5400+	Epson DFX-5000+
List price (base configuration)	\$1,449.00	\$229.00	\$2,999.00	\$239.00	\$299.00	\$349.00	\$1,899.00
Dimensions (HWD, in inches)	8.3 x 18.3 x 13.8	6.6 x 15.2 x 9.7	10.9 x 25.4 x 15.6	5.4 x 10.8 x 15.3	5.1 x 9.8 x 14.8	6.3 x 17.1 x 14.5	14.5 x 27.6 x 15
Weight (pounds)	26.5	8.0	50.0	8.8	10.0	14.8	63.9
Printer type	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix
Carriage size/Number of pins or hammers	Narrow/24	Narrow/24	Wide/24	Narrow/9	Narrow/24	Narrow/24	Wide /9
Parallel/serial port	■ ■	■ □	■ ■	■ ■	■ □	■ Optional	■ ■
Rated noise level in standard/quiet mode (dB)	65, 55	48, N/A ^①	53, N/A ^①	47.5, N/A ^①	46.5, N/A ^①	46.5, N/A ^①	55, N/A ^①
Paper Handling							
Rated maximum paper weight (pounds)	N/A ^②	24	24	24	24	24	22
Supports multipart forms	■	■	■	■	□	■	■
Number/thickness of multipart forms (inches)	6, 0.02	3, 0.01	6, 0.19	3, 0.01	N/A ^①	4, 0.01	6, 0.02
Paper paths	Front U, rear U	Rear U (optional), front L	Rear U, front S, bottom vertical, front L	Rear U, front S	Front L, rear L (optional)	Top U, rear U, front S, bottom vertical, front L, rear L	Front L, rear L
Fonts and Features							
Emulations	Epson LQ series, IBM Proprinter	Epson LQ series, IBM Proprinter	Epson LQ series (optional), IBM Proprinter (optional)	Epson FX series	Epson LQ series	Epson ESC/P2	IBM Proprinter II, Epson ESC/P, Epson FX series
Total number of fonts/scalable fonts	4, None	6, 2	8, None	3, None	10, 4	14, 4	4, None
Supports PostNet/other bar codes	□ ■	■ □	■ ■	□ □	□ □	□ □	■ ■
Prints in landscape mode/color	□ □	■ ■	■ Optional	■ Optional	■ Optional	■ □	□ □
Customer Support							
Toll-free technical support	■	■	■	■	■	■	■
Telephone support hours (eastern time)	11:30-8:00 M-F	8:30-5:00 M-F	8:30-5:00 M-F	9:00-9:00 M-F	9:00-9:00 M-F	9:00-9:00 M-F	9:00-9:00 M-F
BBS or on-line service	■	■	■	□	□	□	□
Warranty (parts and labor)	2 years	2 years	1 year	2 years (limited)	2 years (limited)	2 years (limited)	1 year (limited)
Reader service card number	458	459	459	460	460	460	460

N/A ^①—Not applicable: The product does not have this feature.N/A ^②—Not applicable: The C. Itoh ProWriter C-610III Multifunction Printer prints thick items (like bank books) that dot matrix printers do not normally handle.

of these two units. Its scores of 46 cps for letter-quality text and 1.0 gppm for monochrome graphics put it in the middle of the 24-pin pack. The DECwriter managed slower-than-average text speed (42 cps in letter-quality mode) but average graphics speed (0.9 gppm). Text was dark and characters well formed, but there was noticeable banding on gray-scale graphics. Color output from the DECwriter was bright with no banding, though colors had a tendency to smear. After printing about five pages of text, each printer tended to go into a "cool down" mode.

The Digital LA600 MultiPrinter is the model of ruggedness. Designed to be networked in an office environment, this printer offers a slew of simultaneous paper-feed options, including tractor feed and the use of up to three paper cassettes. This heavy-duty unit has no trouble printing on card stock and multiform documents. Options are easily accessible through the unit's

eight-button keypad with LCD readout.

The Digital LA600 was impressively fast, spitting out 99 cps in letter-quality mode and 1.9 gppm, ranking it near the top. Print quality varied, however, with the Epson-emulation mode providing the sharpest (and fastest-printing) text. Graphics output across all emulation modes tended to be poor, with very low resolution and dithering. There is no doubt that this machine is built primarily for churning out letter-quality forms, day in and day out.

C-Tech Electronics Inc.

• C. Itoh ProWriter C-410 • C. Itoh ProWriter C-415 • C. Itoh ProWriter C-420 • C. Itoh ProWriter C-425 • C. Itoh ProWriter C-610III Multifunction Printer

BY BILL DYSZEL

Using the C. Itoh brand name, C-Tech Electronics (800-347-4017) has a lineup of four new dot matrix printers aimed at small businesses and home-office users:

the 9-pin, narrow-carriage C. Itoh ProWriter C-410 (\$399 list, \$319 street); its wide-carriage counterpart, the C. Itoh ProWriter C-415 (\$499 list, \$399 street); the 24-pin C. Itoh ProWriter C-420 (\$499 list, \$399 street), and its wide-carriage sibling, the C. Itoh ProWriter C-425 (\$599 list, \$425 street). With just mediocre performance and print quality, these C. Itoh printers do little to distinguish themselves. A fifth C. Itoh offering, the C. Itoh ProWriter C-610III Multifunction Printer (\$1,449 list, \$999 street), is a solid niche offering for the printing of bank books or other thick items that cannot feed through a regular dot matrix printer.

The best feature of the 400-series printers is their flexible paper handling. Multiple paper paths mean you can mix different sizes of paper or envelopes without unloading. The units handle multipart forms well, and C-Tech offers a 20-sheet feeder (\$49 for narrow-carriage units, \$55

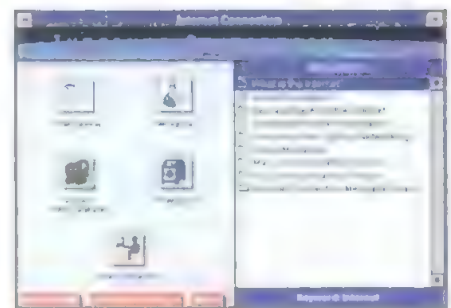
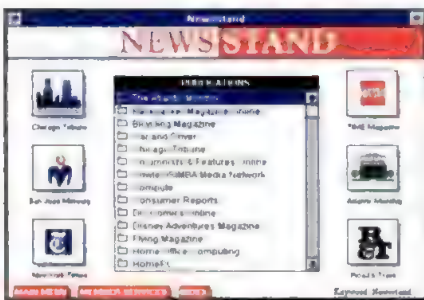
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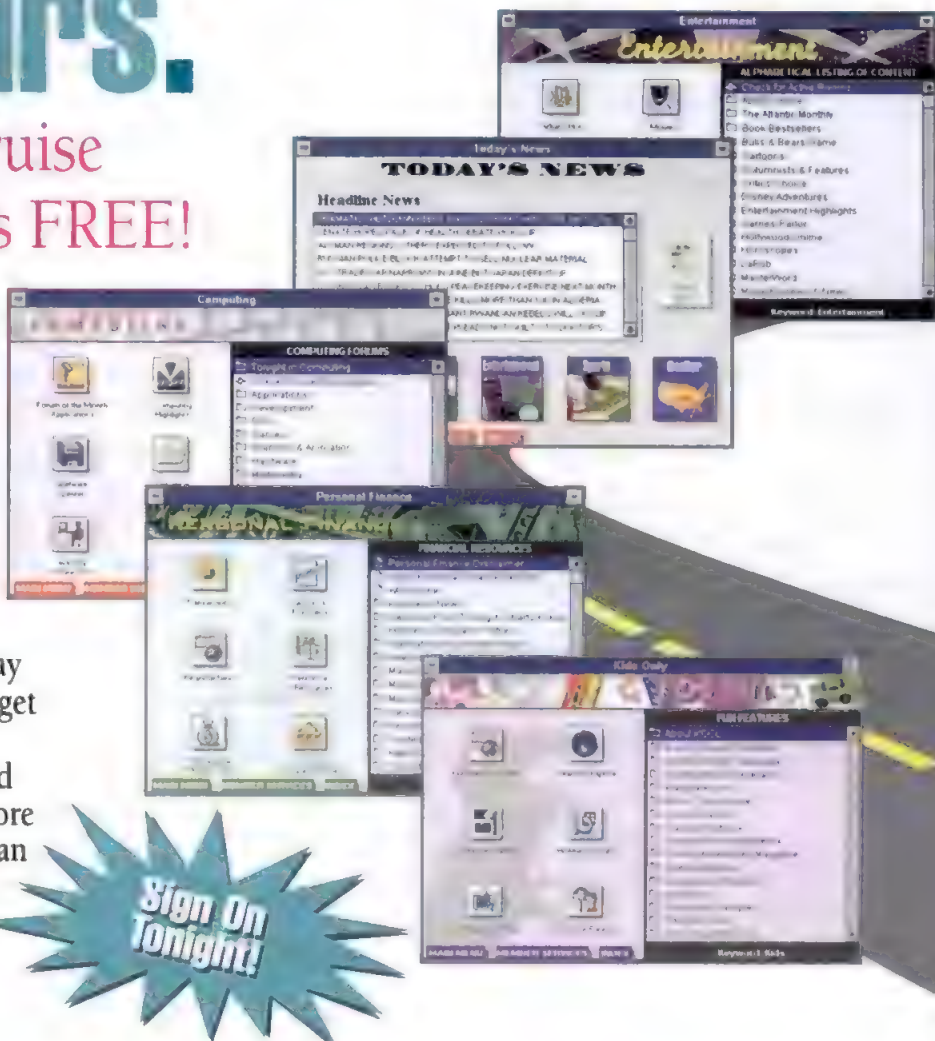
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SUMMARY OF FEATURES

CONTINUES

Dot Matrix Printers



In alphabetical order by company

■ = YES □ = NO

	Fujitsu DL 1150	Fujitsu DL 1250	Fujitsu DL 3800	Fujitsu DL 6400	Genicom 3840EM	Genicom 3840EP	Genicom 4340
List price (base configuration)	\$299.00	\$499.00	\$829.00	\$1,595.00	\$2,595.00	\$3,795.00	\$7,495.00
Dimensions (HWD, in inches)	7.6 x 18.1 x 9.8	7.6 x 20.7 x 9.8	5.1 x 22.4 x 13	12.8 x 23.8 x 11.8	12.1 x 28.9 x 13.9	12.1 x 28.9 x 15.7	42 x 26.5 x 25
Weight (pounds)	12.8	13.9	18.7	55.0	52.0	54.0	170.0
Printer type	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Line
Carriage size/Number of pins or hammers	Narrow/24	Wide/24	Wide/24	Wide/24	Wide/18	Wide/18	Wide/66
Parallel/serial port	■ ■	■ ■	■ ■	■ ■	■ ■	■ □	■ ■
Rated noise level in standard/quiet mode (dB)	52, N/A	52, N/A	49, N/A	55, N/A	55, N/A	55, N/A	54, N/A
Paper Handling							
Rated maximum paper weight (pounds)	22	22	22	22	25	100	100
Supports multipart forms	■	■	■	■	■	■	■
Number/thickness of multipart forms (inches)	4, 0.01	4, 0.01	4, 0.01	8, 0.03	8, 0.03	8, 0.03	8, 0.03
Paper paths	Rear L	Rear L	Rear L	Front S, rear L (optional)	Rear U, bottom vertical, front L, rear L	Bottom vertical, front L, rear L	Bottom vertical

Fonts and Features

	Epson LQ series, IBM Proprinter	Epson LQ series, IBM Proprinter	IBM Proprinter	IBM Proprinter	Epson FX series, IBM Graphics Printer, IBM Proprinter	Epson FX series, IBM Graphics Printer, IBM Proprinter	Epson FX series, IBM Proprinter
Emulations	15, None	15, None	10, 3	11, 3	9, None	8, None	8, None
Total number of fonts/scalable fonts	□ ■	□ ■	□ ■	□ □	■ ■	■ ■	■ ■
Supports PostNet/other bar codes	■ Optional	■ Optional	■ Optional	■ □	■ □	□ □	■ □
Prints in landscape mode/color	□	□	□	□	□	□	□
Customer Support							
Toll-free technical support	□	□	□	□	□	□	□
Telephone support hours (eastern time)	10:00-8:00 M-F	10:00-8:00 M-F	10:00-8:00 M-F	10:00-8:00 M-F	8:00-6:00 M-F	8:00-6:00 M-F	8:00-8:00 M-F
800 or on-line service	■	■	■	■	■	■	■
Warranty (parts and labor)	2 years	2 years	2 years	1 year	1 year	1 year	90 days on-site, 1 year return
Reader service card number	461	461	461	461	462	462	462

N/A — Not applicable. The product does not have this feature.

for wide-carriage units). Changing fonts using the control panel is easy, but for adjusting other settings you may find yourself printing out the entire setup to toggle through the choices line by line.

On our print tests, all four printers turned in fairly average scores in draft mode, but letter-quality print speeds dropped to below average: 39 cps for the 9-pin printers and 47 cps for the 24-pin units. Draft text was comfortably readable, but we found an unusual and unacceptable problem in letter-quality mode: All characters with descenders were pushed up, so each descender rested on the baseline. Gray-scale graphics samples displayed fading and banding.

The C-610III has a traditional tractor feed for continuous paper and can accept thick items fed into the front. The printer setup lets you store three different user configurations in memory. The front control panel's LCD window makes it easy to

change settings without upsetting what's being printed.

At 98 cps in draft mode and 51 cps in letter-quality mode, the C-610III fared about average in the group of 24-pin units. Print quality was excellent, with well-formed characters in each mode and dark, crisp letter-quality output.

Epson America Inc.

• Epson LX-300 • Epson ActionPrinter 3260
• Epson DFX-5000 • **EDITORS CHOICE** • Epson
ActionPrinter 5000+

BY HOWARD ALEXANDER

This lineup of Epson America (800-289-3776) offerings ranges from an affordable printer designed for individual use to a high-volume networked unit designed for heavy-duty office use.

The inexpensive, color-capable Epson LX-300 (\$239 list, \$169 street) offers unexceptional performance for students and home-office users. For only \$30

more, the color-capable Epson ActionPrinter 3260 (\$299 list, \$199 street) offers more features and better performance. The Epson ActionPrinter 3260 and its two-time Editors' Choice-winning sibling, the Epson ActionPrinter 5000+ (\$349 list, \$249 street), are ideal for small businesses. The Epson DFX-5000+ (\$1,899 list, \$1,399 street) is a blazingly fast high-output printer for the corporate market.

The LX-300's single-sheet feed system worked flawlessly, and we had no problems using single and multiform paper with the tractor feed. The unit could not handle card stock, however. Draft-mode text had a "dotty" appearance, but NLQ text was better (though characters were thin). Letter-quality mode produced crisp, nicely formed characters. You pay for the quality with your time, though: Letter-quality print speed was a poky 33 cps. Gray-scale

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CIRCLE 304 ON READER SERVICE CARD

► SUMMARY OF FEATURES

ENDS

Dot Matrix Printers

In alphabetical order by company ■ = YES □ = NO	Mannesmann Tally T6082	Panasonic KX-P1150	Panasonic KX-P2135	Samsung SP-0912	Samsung SP-2412	Samsung SP-2417	Star Micronics NX-2450 Rainbow	Star Micronics NX-2480 Rainbow
List price (base configuration)	\$8,799.00	\$169.95	\$299.95	\$199.00	\$279.00	\$299.00	\$249.00	\$329.00
Dimensions (HWD, in inches)	42 x 32 x 28	5.3 x 17.1 x 12.4	5.8 x 17.1 x 12.4	4.45 x 15.8 x 14.2	11.8 x 15.8 x 14.2	4.5 x 15.8 x 14.2	7.7 x 15.2 x 18.8	6.8 x 18.6 x 14.6
Weight (pounds)	260.0	10.6	11.0	18.7	18.0	9.5	13.9	16.1
Printer type	Line	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix
Carriage size/Number of pins or hammers	Wide/66	Narrow/9	Narrow/24	Narrow/9	Narrow/24	Narrow/24	Narrow/24	Narrow/24
Parallel/serial port	■ ■	■ □	■ □	■ ■	■ Optional	■ ■	■ Optional	■ Optional
Rated noise level in standard/quiet mode (dB)	50, N/A	55, N/A	46.5, 43.5	58, N/A	60, 55	46, N/A	51, 48	46, 44.5
Paper Handling								
Rated maximum paper weight (pounds)	100	24	24	36	36	35	24	24
Supports multipart forms	■	■	■	■	■	■	■	■
Number/thickness of multipart forms (inches)	6, 0.03	4, 0.01	4, 0.01	4, 0.16	4, 0.33	4, 0.33	2, 0.61	3, 0.01
Paper paths	Front S	Rear U	Rear U	Rear U, rear L	Front S, bottom vertical	Rear U, front L, rear L	Rear U, rear L	Rear U, bottom vertical
Fonts and Features								
Emulations	Epson FX series, IBM Proprinter	Epson FX-850, IBM Proprinter III	Epson LQ-850, IBM Proprinter X24E	Epson FX series, Epson LQ series, IBM Graphics Printer, IBM Proprinter	Epson FX series, IBM Graphics Printer, IBM Proprinter	Epson FX series, Epson LQ series, IBM Graphics Printer, IBM Proprinter	Epson LQ series, IBM Proprinter	Epson LQ series, IBM Proprinter
Total number of fonts/scalable fonts	6, None	7, None	10, None	3, None	6, None	8, None	9, None	18, 15
Supports PostNet/other bar codes	■ ■	□ □	□ □	□ □	□ □	□ □	□ □	□ □
Prints in landscape mode/color	■ □	■ □	■ ■	■ □	■ □	■ Optional	□ ■	□ ■
Customer Support								
Toll-free technical support	■	■	■	■	■	■	□	□
Telephone support hours (eastern time)	10:00-8:00 M-F	9:00-7:00 M-F	9:00-7:00 M-F	9:00-6:00 M-F	9:00-6:00 M-F	9:00-6:00 M-F	10:00-5:00 M, 9:00-5:00 Tu-F	10:00-5:00 M, 9:00-5:00 Tu-F
BBS or on-line service	■	■	■	■	■	■	■	■
Warranty (parts and labor)	90 days on-site, 1 year return	2 years	2 years	2 years	2 years	2 years	2 years (limited)	2 years (limited)
Reader service card number	463	464	464	465	465	465	466	466

N/A — Not applicable: The product does not have this feature

graphics throughput (0.8 gppm) showed heavy dither patterns and banding. The optional color kit (\$49) printed cleanly, with little smearing.

One unique feature of the 24-pin ActionPrinter 3260 is its ability to be used either flat on the desk or standing vertically like a mini-tower PC. Letter-quality text was sharp and dark, but the letters were not always completely filled in. At 37 cps in quality-text mode, print speed was near the bottom of our test group. Graphics images printed dark, with some loss of detail and noticeable banding. Installing the \$49 color upgrade kit was a relatively simple operation, though colors tended to be muddy.

The 24-pin ActionPrinter 5000+ (also sold as the Epson LQ-570+) truly shines. Letter-quality text was dark, sharp, and well filled in. Even draft text was admirable. Graphic images tended to be dark, but there was virtually no banding,

and the dithering patterns were not obtrusive. Print speeds of 61 cps in letter-quality mode and 1.5 gppm were above average for this class of machine.

We tested all four paper-feed paths (top, bottom, rear, and front) with cut sheets, continuous forms, multipart forms, and card stock and did not experience any jams or misfeeds. Nor did we run into any problems with the printheads overheating.

The DFX-5000+ is a 9-pin monster designed to print out all sorts of forms on a continuous schedule. But its NLQ text, while dark and legible, was not well filled in and looked more like draft text, which was somewhat lighter and had even less "fill." On the other hand, the printer is fast: 84 cps in letter-quality mode and 298 cps in draft mode—some of the fastest numbers we saw. It can handle continuous forms of all widths and thicknesses and offers three optional network interfaces.

Fujitsu Computer Products

- Fujitsu DL 1150 • Fujitsu DL 1250
- Fujitsu DL 3800 **EDITORS' CHOICE** • Fujitsu DL 6400

BY JOSEPH DESPOSITO

Fujitsu Computer Products of America (800-626-4686) targets a broad range of users with its four 24-pin dot matrix offerings: the Fujitsu DL 1150 (\$299 list, \$215 street) and Fujitsu DL 1250 (\$499 list, \$325 street) for individuals and small-office/home-office users, the Fujitsu DL 3800 (\$829 list, \$540 street) for larger businesses that need medium-duty forms processing, and the Fujitsu DL 6400 (\$1,595 list, \$1,180 street) for high-volume use and heavy-duty multipart-forms processing. All these Fujitsu printers have attractive features (including color kits for all but the DL 6400) and offer good value.

The DL 1150 and DL 1250 have a vertically oriented design, which gives each a small footprint (20.7 inches wide by only

9.8 inches deep for the larger DL 1250). The DL 1250 is a true wide-carriage printer, but the DL 1150 is wide enough to handle letter-size paper in a landscape orientation. Each printer has a generous 15 built-in fonts and an optional 80-sheet bin feeder. Setup should prove no problem for novices, and the control panel lets you easily toggle through options. Draft-mode text is easy to read, and letter-quality output (which printed at a respectable 49 cps) is dark and crisp. But gray-scale graphics images (produced at a slow 0.6 gppm) tend to look blurry.

The DL 3800, with a removable tractor feed, lets you choose between rear feed and bottom feed for continuous-form paper. Text quality was nearly identical to that of its siblings, and speed (82 cps in letter-quality mode) was above average. Graphics output here again was disappointing, and the color kit (\$85) produced poor, badly smeared output.

The DL 6400 is clearly designed for heavy-duty networked applications. The straight paper path (paper loads through the front) minimizes paper jams, and an optional rear tractor lets you have two paper sources loaded at once. Built-in commands let you print bar codes. Characters were crisp and well formed in both draft and letter-quality modes and spewed from the machine at 212 cps in draft mode and 116 cps in letter-quality mode—the quickest letter-quality output among the 24-pin units.

Genicom Corp.

• **Genicom 3840EM** • **Genicom 3940IP**
• **Genicom 4840**

BY JOSEPH DESPOSITO

The heavy-duty dot matrix printers from Genicom Corp. (800-436-4266), the Genicom 3840EM (\$2,595) and Genicom 3940IP (\$3,795), are targeted primarily at business and industrial users working in shared-resource environments. With fine performance and attractive features, the 3840EM is a solid choice, and the 3940IP merits a look for IBM mainframe environments. If you need a high-volume high-speed line printer, consider the Genicom 4840 (\$7,495). Good performance and a shuttle mechanism backed by a lifetime warranty make it a good bet.

The 3840EM and 3940IP are 18-pin printers that are nearly identical in design. Rear and front tractor feeds are standard,

which means you can load two forms simultaneously. Nine fonts and bar code capabilities are also standard, and the printers accept font cartridges. Unlike the 3840EM, the 3940IP sets the print-head gap automatically and has a built-in interface for linking to IBM mainframes.

Letter-quality text was crisp and dark, but draft characters were poorly filled. Intended for text-intensive chores, the printers produced gray-scale graphics output that was dark and lacking definition. Draft-text output was among the fastest here—231 cps for the 3840EM and 235 cps for the 3940IP—but letter-quality print speeds of 105 cps and 106 cps, respectively, lagged those managed by the other units in this price range.

Avoiding the typical box design, the 4840 has a clean high-tech look. Its 66-hammer shuttle mechanism produced 442 lpm in draft mode and 170 lpm in quality mode. This is slower than what the Mannesmann Tally T6082—the other line printer we looked at—managed (366 lpm draft and 267 lpm quality), but the 4840 was faster on our DOS-based Graphics Speed test and on all of our Windows applications tests.

The paper exit is at the back of the printer, but there is also a top exit for quick access to multipart forms or other output, and like the other Genicom printers, the 4840 has nine built-in fonts and bar code capabilities. Output quality was similar to that of the other Genicom units, with dark letter-quality text but poor graphics.

Mannesmann Tally Corp.

• **Mannesmann Tally T6082**

BY JONATHAN HILL

If speed and volume are what you need, look no further than this wide-carriage workhorse from Mannesmann Tally (800-843-1347). The Mannesmann Tally T6082 is pricey (\$8,799 list, \$8,000 street), but it's capable of spitting out nearly 15 pages per minute of draft text, while punching through multipart forms of up to 10 pages.

The T6082 is a true line printer, but advanced sound-deadening techniques reduce noise levels to below that of many laser printers. Open the cover, though, and you'll wake the dead.

Printer setup was straightforward. The dual banks of pull tractors are independently adjustable, and the paper path is straight to minimize snags. The T6082 can

also print bar codes and features automatic switching between serial and parallel ports. An optional IBM twinaxial/coaxial/parallel interface allows for simultaneous connection to mainframes and a PC network.

But speed is the story here. The T6082 bested the Genicom 4840, the other line printer here, in churning out text on our Text Speed test: 272 lpm in letter-quality mode and 457 lpm in draft mode. At 1.9 gppm, graphics print speed lagged the 4840's 2.1-gppm throughput, and gray-scale images were too dark, with poor detail. Text output was better, with dark (if not particularly crisp) characters.

Panasonic Communications & Systems Co.

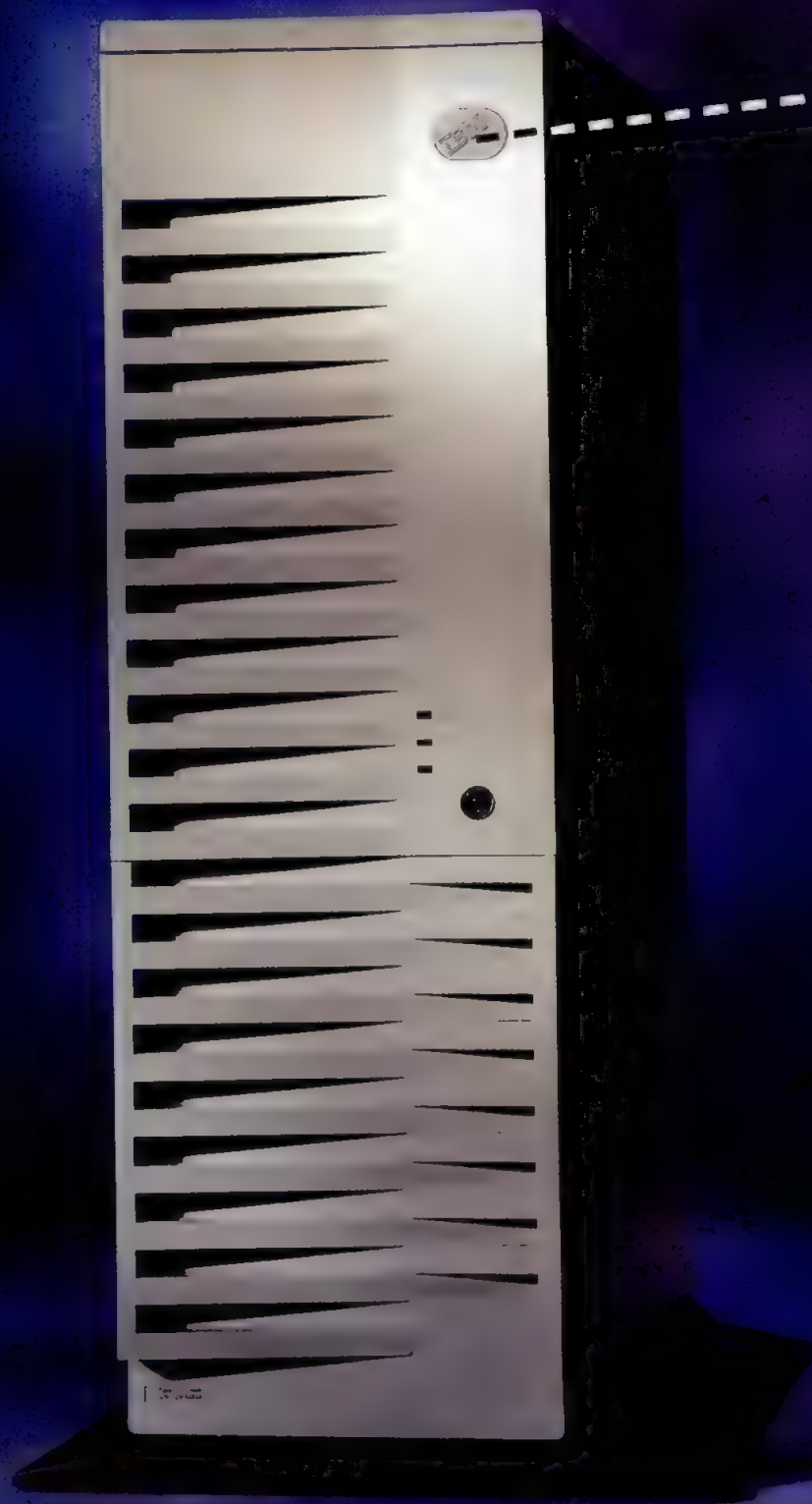
• **Panasonic KX-P1150** • **Panasonic KX-P2135**

BY JONATHAN HILL

Panasonic Communications & Systems Co. (800-742-8086) is targeting the home and small-business segments with its new dot matrix offerings. The narrow-carriage 9-pin Panasonic KX-P1150 (\$169.95 list, \$139 street) is targeted at students and home users on limited budgets, while the 24-pin Panasonic KX-P2135 (\$299.95 list, \$249 street) is directed at budget-conscious small businesses and home users who occasionally dabble with color. (The monochrome-only Panasonic KX-P2130 is also available and is priced at \$249.95 list, \$199 street.) All models share Panasonic's DOS-based installation program and setup utility, which simplifies configuration and control-panel choices with easy-to-use on-screen menus.

The KX-P1150 can emulate either an Epson FX-850 or an IBM Proprinter III and ships with an updated Epson FX driver for Windows 3.1. Only NLQ fonts are offered in addition to the three draft fonts, but NLQ text is dark and clean. Print speed, however, was the slowest we saw during testing: 26 cps.

The KX-P2135 includes seven true letter-quality fonts and also features a "super quiet" mode and a 20-sheet bin feeder. An optional 50-sheet feeder also fits the KX-P1150. Text output speed was again on the slow side (48 cps), but letters were well formed and crisp. Graphics output speed was a quick 1.3 gppm, and output was fairly well detailed and considerably better than the KX-P1150's muddy, banded results. Color output showed some smearing, but we found it acceptable for a printer in this class.



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Samsung Electronics America

- Samsung SP-0912 • Samsung SP-2412
- Samsung SP-2417

BY JONATHAN HILL

Versatile paper handling distinguishes these three units from Samsung Electronics America (800-933-4110), but they are remarkable mainly for a lack of attention to detail. The 9-pin Samsung SP-0912 (\$199 list, \$120 street) and 24-pin Samsung SP-2412 (\$279 list, \$160 street), for example, lack paper guide marks on their chassis, making lining up tractor-fed paper a hassle. The color-capable 24-pin Samsung SP-2417 (\$299 list, \$190 street) does not suffer from this problem, but neither it nor its lower-priced siblings ship with any driver or installation software. All three printers are heavily discounted on the street; if all you need is inexpensive text output, and you don't mind some rough edges, these units are worth considering.

All three printers can handle single cut sheets and both bottom- and rear-feed tractor paper. The SP-2417 adds a clever

LaserJet-style cut-sheet bin that holds about 50 additional sheets in a tray that slides underneath the unit.

Letter-quality characters are dark and nicely formed, and output speeds during testing were average for their classes. Gray-scale images were muddy, with noticeable banding. Colors produced by the SP-2417 were smeared and blended—the worst we saw.

Star Micronics America Inc.

- Star Micronics NX-2450 Rainbow
- Star Micronics NX-2480 Rainbow

BY DEVAL SHAH

Star Micronics America (908-572-5550) is going after the small-office/home-office market with its 24-pin color dot matrix units, the Star Micronics NX-2450 Rainbow (\$249 list, \$229 street) and Star Micronics NX-2480 Rainbow (\$329 list, \$259 street).

Unlike most dot matrix printers, the boxy NX-2450 has a 55-page cut-sheet feeder as its standard input; a push tractor is a \$24.50 option. The unit offers nine letter-quality fonts, and letter-quality

characters were crisp and well formed during testing. The unit's 44-cps output speed was about average. Gray-scale output under DOS—an average 0.7 gppm—showed poor detail, but Windows output was much improved. Color was vivid and very impressive, with no smearing.

The faster (56 cps in letter-quality mode) NX-2480 has more traditional paper-handling capabilities: three paper paths (rear, bottom, and top) for continuous-form paper and an optional cut-sheet feeder (\$129). The unit has a generous 18 bitmapped fonts, along with 15 scalable TrueType fonts. Characters during testing were crisp and well formed, but color output showed some smearing.

Each unit offers a zoom option to scale graphics. Electronic DIP switches, adjustable through each printer's control panel, let you set user-controlled options. A series of LEDs indicates which options are selected, but you'll need to have your manual handy to decipher the combinations. □

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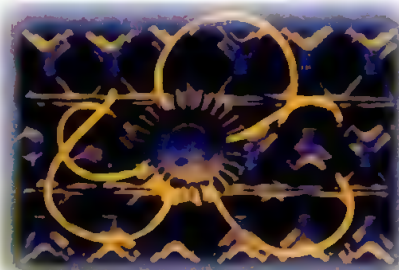
First Looks

► MULTIPROTOCOL PRINT SERVERS

Print Servers for All Seasons

Until networks run on a single protocol, multiprotocol printing will be a stormy issue. Here's a look at eight products that will help you through all kinds of weather.

By Tony Pompili



As networks continue to carry a mix of IPX, IP, and EtherTalk traffic, network managers need simple ways to provide printing solutions across all environments. A multiprotocol print server is one such solution. Though print servers have long supported IPX and IP protocols, over the past twelve months they've picked up EtherTalk support (the AppleTalk protocol for running Macintoshes over Ethernet). Last year only a few multiprotocol print servers offered EtherTalk (see "Multiprotocol Printing," Network Edition, December 7, 1993).

Indeed, this year we found eight such print servers that challenge network managers to consolidate their printing needs: the Axis NPS-530/E, Digital Products' NetPrint/200, Emulex Corp.'s

NetQue, Hewlett-Packard Co.'s HP JetDirect EX, Intel Corp.'s Netport-Express XL, the Lantronix EPS1, the Microplex M202, and MiLAN Technology Corp.'s FastPort 3000. By supporting EtherTalk, IP, and IPX, these print servers allow Macintoshes,

NetWare clients, and Unix workstations, respectively, to share a single printer.

Why external multiprotocol print servers? Sure, printer manufacturers from HP to Phaser have multiprotocol print-server card options that you can

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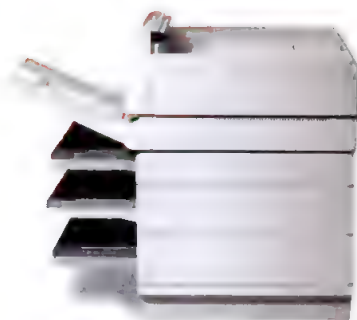
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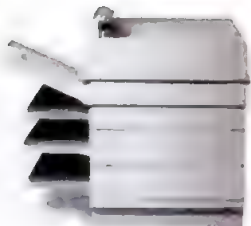
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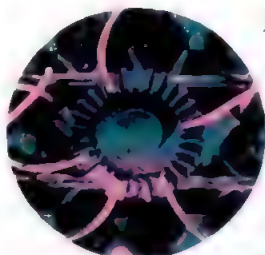
Multiprotocol Print Servers

CONTINUED FROM NE1

add to existing printers to allow PCs, Macs, and even Unix workstations to print to the same printer without the need for an external print server. But what about those manufacturers that don't offer these built-in options for their printers or that three-year-old printer that won't even accept an adapter. The answer might be that it's time to look at an external multiprotocol print server. We chose HP's JetDirect as our Network Edition Editors' Choice for its outstanding NetWare and Unix installation and management software, and its overall support for EtherTalk, IP, and IPX. For Unix sites committed to standard LPD printing, we'd suggest taking a look at the flexible and easy-to-install Microplex M202.

Each of the print servers uses at least one standard printing method supported by the NetWare, Unix, and Macintosh platforms. NetWare networks use two methods to print. The first, and more popular, is Print Server (PSERVER). The PSERVER method spools print jobs to

the NetWare server. The second method, Remote Printer (RPRINTER) uses SPX to print directly to the print server. There is no spooling to the NetWare server. PSERVER is faster, because it uses IPX



*Each of the reviewed
print servers uses at
least one Macintosh,
NetWare, or Unix
printing standard.*

and it spools, freeing up workstations and passing the print job quickly on to the print server. On the other hand, networks that have a limited number of user accounts might want to consider RPRINTER. For each PSERVER device, NetWare uses at least one user account, whereas RPRINTER doesn't use any accounts and supports up to 16 printers per server.

The most common Unix printing method comes via support for the Line Printer Daemon (LPD)—a Unix printing program that provides a direct connection

between the host and printer. HP is the only vendor here that does not integrate LPD support. It will offer it as a \$99 option.

To support Macs, print servers use Apple's Printer Access Protocol (PAP), a transport-level protocol used by EtherTalk to talk to the printers. PAP packets are sent directly from the Mac to the printer, or in this case, the print server. The Mac's Print Monitor program handles queuing and displays printer status information. Print Monitor, similar to the Windows Print Manager, only spools to the local Mac, eliminating server-level spooling. Generally, Mac print-server printing is accomplished by simply connecting the print server to the network; the print server then automatically shows up on the Mac's Chooser (a program similar to the Printers dialog box in Windows' Control Panel).

Apple's bidirectional printing requirement is another important element in Mac printing. Macs expect two-way communications with printers. For example, they poll a printer, usually a PostScript printer, to find out what fonts and dictionaries (print configuration information) are already downloaded to the printer. If no new fonts or printer settings need to be downloaded, the job begins immediately. Otherwise, the new fonts or settings are first downloaded. If the Mac can't get this information, it waits and then assumes the printer does not have the correct fonts or configuration settings and sends them again. This is how most print servers work, which can create short delays in printing. Units such as Digital Products' NetPrint/200 don't actually poll the printer, but they do immediately send back a static setting. In most cases, fonts and configurations still are sent to the printer, but the time-out delay associated with waiting for printer feedback is eliminated. With the exception of the JetDirect, all of the print servers support at least one of the standard printing methods for each platform.

Suitability To Task: Multiprotocol Print Servers

Monitoring Here we rate how well the print server's software pumps out the necessary status information to the person who needs to see it—the network administrator. This much-needed information includes printer, job, and print-server status. We also look at how easy it is to monitor this information, primarily from a NetWare PC, but also from Unix and Macintosh workstations.

Compatibility By their nature, multiprotocol print servers are in a technical quagmire. How well they deal with the various compatibility issues is key. We evaluate each server's ability to support our test-bed's common setups, including Ethernet, 802.3 frame types, serial and parallel printer interfaces, NetWare PSERVER printing, and Unix's LPD printing.

Installation From its shipping box to its physical location on the network, we look at the setup tools

provided by each vendor for connecting the print server to the network and printers. We look to see if the vendor supplied hardware tools

such as LEDs on the print server for reporting error conditions and for software that confirms connections or troubleshoots problems. We check for problems with physical interfaces to the network and printers and whether DIP switches must be set.

Configuration The tools for making the print server work with specific NetWare servers, printers, and Unix and Mac networks are important. Here we look at the basics such as configuring the print server to monitor NetWare print queues and servers, setting up protocols on ports, creating print-server models (when necessary), and assigning an IP address to the print server.

SUITABILITY TO TASK

Company Name	
Monitoring	POOR
Compatibility	FAIR
Installation	GOOD
Configuration	EXCELLENT

SPLIT DECISION

While all of the products support all three protocols, the companies were split in their approach to management, specifically con-

Continues on page NE6

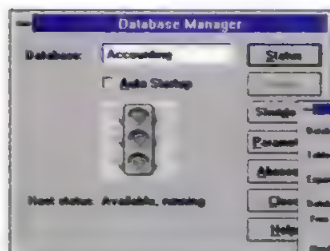
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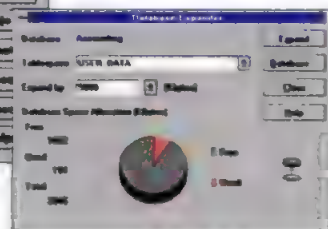
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Multiprotocol Print Servers

CONTINUED FROM NE4

figuration, installation, and monitoring. We found that the print servers break into two management camps—desktop-based (PCs and Macs) and Unix-based. Deciding on the appropriate management platform comes down to certain key configuration and management issues. Configuration considerations include what sort of interface you have and what options there are for setting up print-server parameters such as the IP address, types of supported protocols, and print-server names. On the management side, look at which of the servers have administrative software that can supply information such as the status of the print server and all attached printers. This information should be reported in a clear, concise and friendly way.

The desktop approach to multiprotocol print servers is spearheaded by the desktop-based companies, Digital Products, HP, and Intel. The HP JetDirect and Intel's NetportExpress each are geared toward desktop LAN managers, giving them powerful and intuitive Windows interfaces for configuring and monitoring print servers from the PC side. To a lesser degree, Digital Products' NetPrint also offers Mac and PC interfaces. The character-based DOS PC interface is not quite as well designed as its Intel and HP counterparts, however. All of these interfaces let us easily manage and configure multiple print servers on the network with just a few keystrokes or mouse clicks.

The other approach for print servers focuses on Unix/IP-based products for the Unix administrator. If you're coming from the Unix camp, look at products such as the Axis NPS 530/E, Emulex's NetQue, the Lantronix EPS1, the Microplex M202, and MiLAN's FastPort. These products offer installation and configuration tools familiar to the Unix user such as the use of telnet instead of the PC's windowed interface. Once you've logged on, you use traditional Unix, character-based commands, such as "show server status." Unlike the graphical or character-based interfaces on the desktop side, we found this log-on method more cumbersome, since we had to log on to each server individually. An exception to this



• HP JetDirect EX

The HP JetDirect EX stands out from the crowd of external multiprotocol print servers with its powerful and easy-to-use PC and Unix management services. Hewlett-Packard Co. pays careful attention to both the desktop administrator's and end user's needs with JetAdmin for Windows and

JetDirect, respectively. The Unix version of JetAdmin and the HPNPNConfig installation program are the easiest menu-driven Unix printer configuration and management systems we tested.

Admittedly this Editors' Choice is given with the NetWare folks in mind. While all of the other print servers tested here had built-in, standardized Unix LPD printing, LPD printing on the JetDirect EX is a \$99 option. Furthermore, you have to order the JetAdmin for Unix software separate-

ly, another \$199. The other vendors offering Unix installation packages—albeit less powerful software—shipped them with their print servers.

The Microplex M202 is another product reviewed in this roundup that deserves recognition. For the Unix shop, the Microplex M202 is a well-engineered print server that supports up to four printers. Microplex offers flexible printer configuration, an automated Unix installation (which is second only to HP's), and excellent documentation.

was MiLAN's ACT DOS-based interface that provided some of the most extensive status feedback of all the servers tested. Vendors such as Axis, Lantronix, and Microplex included products for logging on to the server from Unix and PC workstations and Lantronix also included Maccon for logging on to the Mac.

Several of the products, including the Axis NPS 530/E, support SNMP—a commonly used protocol for managing network devices. SNMP is based on a set of variables known as MIBs (management information bases). Currently MIBII offers little support for printers. To get around this, companies write their own private MIBs. Although this means the devices can be monitored from the same network management system that monitors standard SNMP MIBs, these private MIBs relate solely to a device from a single vendor, circumventing some of SNMP's centralized management capabilities. A new standard, the desktop management interface (DMI) should help this situation. Since DMI addresses printer-, and desktop workstation-specific monitoring issues, it promises to provide

a uniform method of managing devices from multiple vendors. For additional information on printer management, see the sidebar "Fewer Walks Down the Hall" in the departmental laser printer section of this issue, "Fast and Flexible."

Price is not inconsequential, especially since network managers tend to buy print servers by the dozen. The print servers tested for this roundup ranged from \$399 for the JetDirect to \$995 for the NetPrint/200. Some of the prices need some explanation, or they can be a bit deceiving. For example, we found the JetDirect's \$399 price tag misleading, because in order to get full Unix functionality we had to add another \$99 for LPD printing and another \$199 for JetAdmin for Unix, the Unix-management software. If, however, you are only supporting a single printer at any printer site, and you want a nice blend of all three platforms, we still think the JetDirect is probably the best deal. If you expect to be fully populating your print servers, the Microplex M202 is a bargain at \$595 for two parallel and two serial ports, with the Lantronix

Continues on page NE8

Network Printing Solutions

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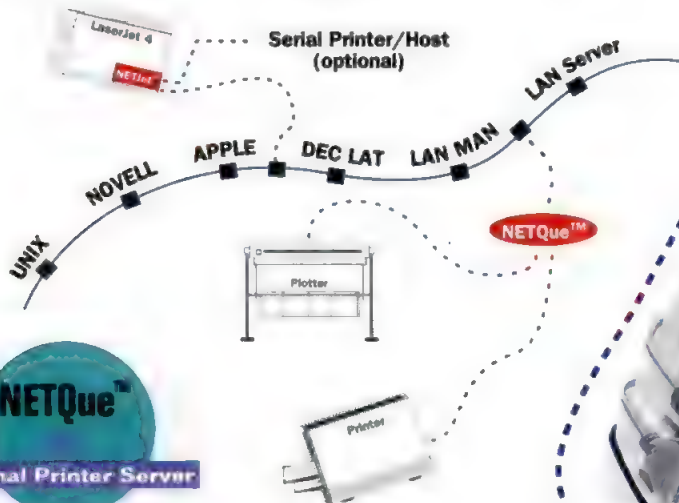
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Multiprotocol Print Servers

CONTINUED FROM NE6

EPS1 a close second (providing two ports for \$495). The NetPrint, though it also has four ports, is a bit overpriced at \$995.

Another factor warranting consideration is the physical size of the print server. All of the units tested are relatively small, ranging in size from that of a VHS tape to a cigarette pack. Each supports BNC or 10BaseT network connections, and most also have an AUI interface. Each print server has a parallel port and most support at least one serial port as well. The Microplex M202 and the NetPrint offer four ports, while the Axis NPS 530/E and the JetDirect have only one parallel port.

Finally, speed, always a primary consideration, turned out to be something of a nonissue in this category. None of the print servers was any faster than the others—at least not when you measure final throughput scores. The vendors will each make certain claims to performance differences. It's not uncommon for them to

tout throughput performance increases on the order of between 50- and 200-Kbps. But speed becomes irrelevant as soon as all of the print servers' throughput hits the printer. You can make an analogy to a sports car that's clipping along and suddenly runs into rush-hour traffic. On our tests each of the print servers took the same amount of time to output a 10-page Microsoft Word text file and a 1MB Word graphics file, even when multiple jobs were being processed simultaneously. The printer bottleneck issue even applies with newer, faster printers, such as the HP LaserJet 4 with its HP Bitronics parallel port, which is rated at 150 Kbps.

Ultimately, you will need to decide for your site whether platform allegiance, ease of management, or price is the driving factor in your print-server purchase. None of the products tested did everything perfectly. But for all practical purposes, these products represent powerful solutions for extending the life of existing printers and handling your mixed network-printing environment.

Axis Communications Inc.

• Axis NPS 530/E

The Axis NPS 530/E packs in rich PC and Unix management and flexible printer configuration features.

The NPS 530/E connects directly to the parallel port of the printer; all of the other tested print servers connect via a printer cable. The single parallel port supports EtherTalk, IP, IPX, and NetBIOS/NetBEUI for Microsoft LAN Manager and OS/2 LAN Server sites.

Unix users of the NPS 530/E will like the Unix print setup script, which speeds up System V and BSD printer installation. To get the unit up and running, we simply downloaded the script to the Unix host, made a few edits, and ran the script. With

Continues on page NE11

SUITABILITY TO TASK	
Axis NPS 530/E	
Monitoring	FAIR
Compatibility	EXCELLENT
Installation	GOOD
Configuration	GOOD

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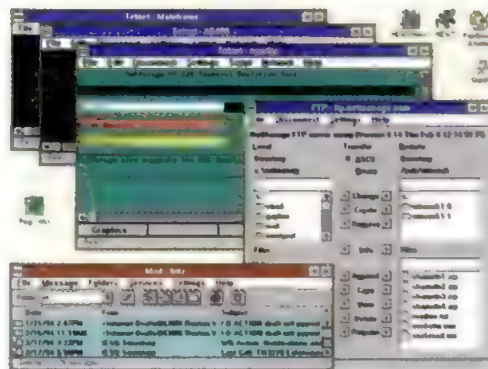
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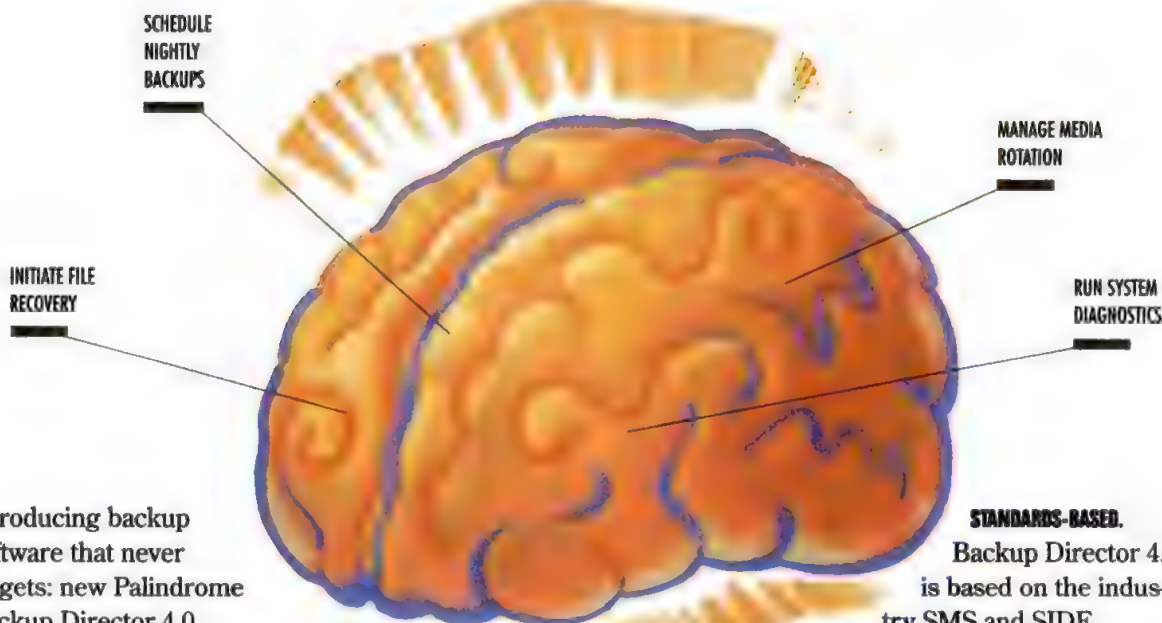
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PALINDROME

Multiprotocol Print Servers

CONTINUED FROM NE8

units like Digital Products' NetPrint/200 and Emulex's NetQue, we had to update manually the Unix PRINTCAP file entry to set up Unix LPD printing. NPS also includes two proprietary print systems, ProsA and ProsB.

NetWare installation uses standard PCONSOLE procedures. Unfortunately, unlike the Unix side, there are no installation or PC setup programs to streamline this process. For Macs, like most of these print servers, setup involved merely connecting the print server to the network; the printer automatically shows up in the Mac's Chooser.

One of this print server's unique qualities is its use of *logical* printers that define printer setup, reset strings, and let you convert print files from ASCII to PostScript formats. Up to eight logical printers can be assigned to the single parallel port. Since the configurations are stored on the NPS 530/E, we were able to use these logical printer configurations from a Unix machine, a PC, or a Mac.

Monitoring comes in two flavors: a private SNMP management information base (MIB) or telnet sessions. The MIB, which installed easily under HP OpenView for Unix/Network Node Manager 3.3, allowed monitoring of all basic printer-status information such as printer on-line and error status. Similar information and the ability to configure the print server itself is available using telnet sessions.

For the PC side, the NPS 530/E comes with a basic program that works almost identically to the IP telnet system, but it uses a crude Windows interface. The program, called AXCFG, let us gather the same status information and make the same configuration changes as with the telnet system. There are no Mac monitoring capabilities.

The NPS 530/E is a good fit for companies looking to consolidate their multiprotocol printing into a single printer with basic management capabilities for all three platforms.

► **Axis NPS 530/E.** List price: \$495. Axis Communications Inc., 99 Rosewood Dr., #170, Danvers, MA 01923; 800-444-2947.

Circle 960 on reader service card

Digital Products Inc.

• NetPrint/200

Digital Products' NetPrint/200 has one of the best Macintosh applications for configuring print servers of the products tested, making it ideal for Mac-oriented environments. Unfortunately, poor print-server status tools and a hefty price tag make the NetPrint a feature-poor product.

The NetPrint takes a desktop-centric approach to installation, providing PC and Mac print-server configuration utilities for setting up server attributes. NetWare queues and print servers are set up with PCONSOLE. The NetPrint and MiLAN Technology Corp.'s FastPort 3000 are the only units here that don't support NetWare's Remote Printer (RPRINTER) program.

Nonetheless, the NetPrint gives the desktop manager tools for setting up the

basics such as IP addresses. Serial port attributes are configured from the NSDoctor program on the PC side and the JetXPrint program on the Mac side. There's no Unix configuration or management interface on the NetPrint, a downside for Unix-oriented sites.

Unix installation of the NetPrint is far less automated than that of other units here. Digital Products includes instruc-

tions for generic and specific BSD and System V operating systems. The instructions we received were incomplete, leaving out such steps as creating Unix IP host entries and copying files from floppy disks.

The NetPrint comes with three parallel ports and a fourth port, called a Uniport that can work either as a parallel or serial port.

NetPrint's management is pretty poor. NSDoctor and JetXPrint address only installation, not monitoring. On the NetWare side, the print server relies on

Continues on page NE15

SUITABILITY TO TASK

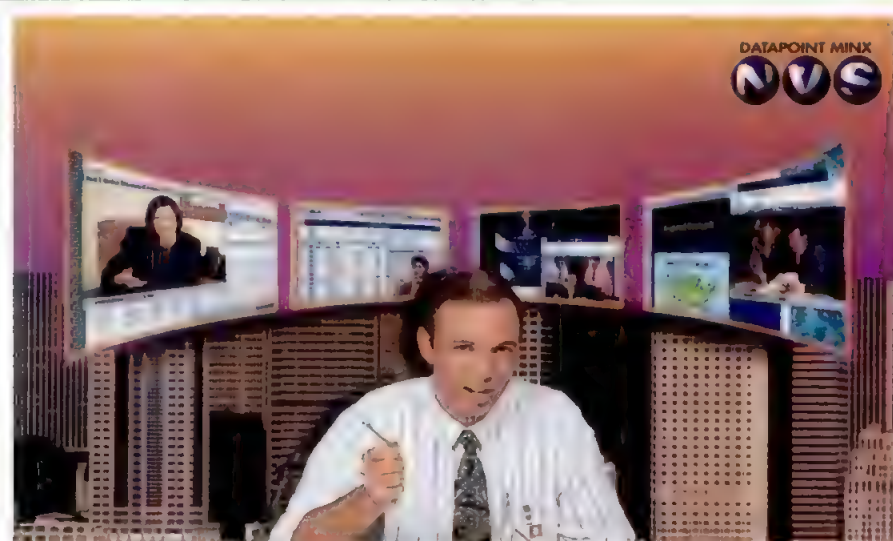
NetPrint/200

Monitoring **POOR**

Compatibility **EXCELLENT**

Installation **POOR**

Configuration **FAIR**



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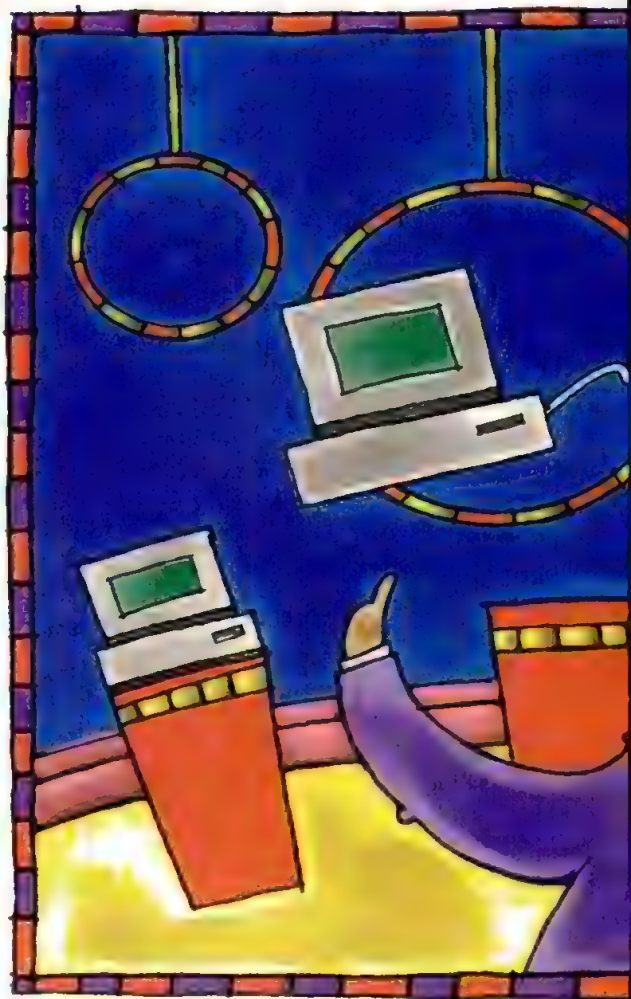
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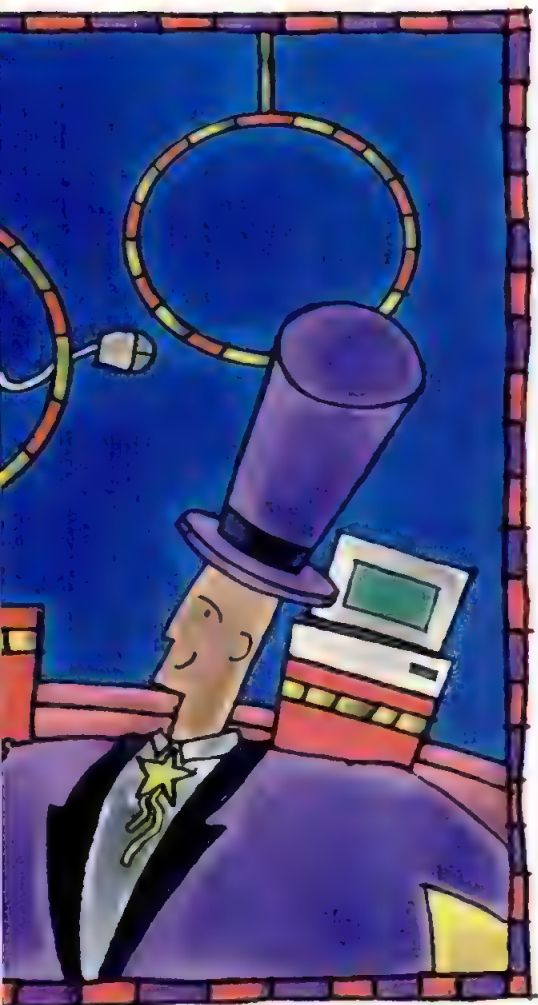
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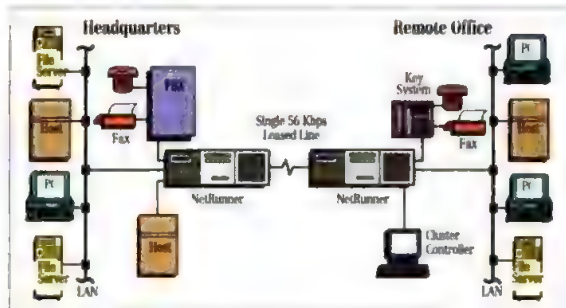


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Multiprotocol Print Servers

CONTINUED FROM NE11

NetWare's PCONSOLE to show job status, but there's no print-server status information. This is a major shortcoming of the NetPrint, making it difficult to manage in large network installations.

Even with its strong PC and Mac support, the NetPrint/200's high price is hard to justify. Its four-port capacity and flexible Uniport make it a good choice for companies that want to install several printers at a single location.

► **NetPrint/200.** List price: \$995. Digital Products Inc., 411 Waverley Oaks Rd., Waltham, MA 02154; 800-243-2333, 617-647-1234.

Circle 961 on reader service card

Emulex Corp.

• NetQue

Emulex Corp.'s NetQue delivers SNMP management, management and configuration across PC and Unix platforms, and a

wide range of protocol options for sites that need a great deal of printing flexibility.

The NetQue has one parallel and one nine-pin serial port. It supports EtherTalk, IP, and IPX, and it can also run LAT, which is popular in Digital Equipment Corp. environments. All four protocols are built in and are activated with Emulex PAKs—software keys that enable protocols.

You configure the NetQue by logging on from either a PC or Unix host. The PC uses a customized combination of the Kermit transfer protocol and an Emulex program called Terminal Emulation Services, while the Unix host uses telnet to communicate with the server. Identical commands make it easy to configure parameters such as the IP address. Like the Axis NPS 530/E and the Microplex M202, the NetQue requires you to enter a series of commands and arguments to change and display settings—a departure from the ease of GUI interfaces.

For NetWare, Emulex uses PCONSOLE to set up queues and print servers manually. Unlike the Axis NPS 530/E, the Lantronix EPS1, and the Microplex M202, the NetQue has no automated setup program.

In addition to LPD printing for Unix, Emulex also has a proprietary printing

program called Rprinter (not to be confused with NetWare's remote printer program). We couldn't test Rprinter because our Unix host didn't have the optional compiler necessary to install it.

To monitor print jobs and printers you use a procedure similar to the setup routine. For Unix and PC platforms, managers log on to the print server and issue commands such as "show port 1".

For sites with SNMP management systems in place, Emulex provides a private management information base (MIB) that can replace this clumsy log-on

Continues on page NE16

SUITABILITY TO TASK

NetQue	
Monitoring	EXCELLENT
Compatibility	EXCELLENT
Installation	EXCELLENT
Configuration	FAIR

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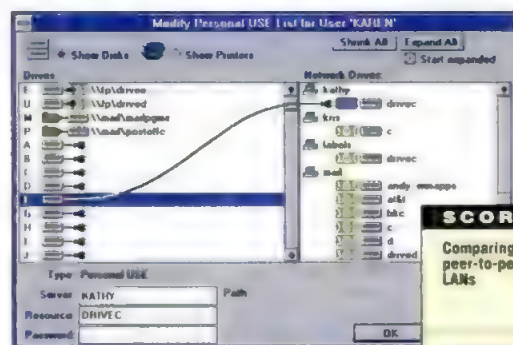
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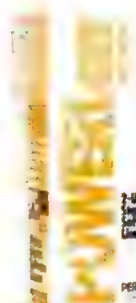
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PC Week
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SCOREBOARD				
Comparing peer-to-peer LANs	PCWEEK LABS	Microsoft Windows for Workgroups 3.11	Microsoft Windows 1.1	Performance Technology, Inc. POWERLan 3.0 for Windows
PCWEEKLABS Overall score	3.2	3.5	3.5	4.0



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PERFORMANCE TECHNOLOGY

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Multiprotocol Print Servers

CONTINUED FROM NE15

method. We tested the MIB with HP OpenView, which made it slightly easier to check such basics as printer status and print-server status, and to display protocol and configuration settings. Like most of the print servers tested for this roundup, the NetQue has no Macintosh management.

If you need a lot of network-protocol flexibility and your emphasis is Unix and NetWare, NetQue is a good choice.

► **NetQue.** List price: \$599. Emulex Corp., 3535 Harbor Blvd., Costa Mesa, CA 92626; 800-854-7112, 714-662-5600. Circle 962 on reader service card

NETWORK EDITION

EDITORS' CHOICE

Hewlett-Packard Co.

• HP JetDirect EX

The HP JetDirect EX, from Hewlett-Packard Co., offers convenient multiprotocol printing, a powerful Windows-based installation, and an automated Unix installation that surpasses others here. Unix folks may not be as accepting of the HP unit since it does not currently support LPD, the Unix printing standard.

This one-parallel-port unit is clearly aimed at desktop network managers who expect intuitive management and configuration programs. Using HP's JetAdmin Windows program, we performed all necessary configuration and management tasks, including setting up NetWare queues and assigning IP addresses. JetAdmin let us monitor the status of individual printers with just a few mouse clicks.

JetDirect is the only product here that supports end user print management. JetPrint, a bundled software product, provides detailed status information on print jobs and automates the distribution of updated Windows print drivers.

HP also offers a Unix version of JetAdmin. Through a menu interface rather than a GUI, JetAdmin for Unix provides print control for features such as duplex printing, especially for HP LaserJet printers, unlike any of the other tested print servers.

HPNPIInstall, which sets up JetAdmin, is one of the most thoughtfully implemented installation systems we've seen. It simplified setup with detailed error messages and a menu-driven interface.

There are a few kinks, though. The JetAdmin for Unix software doesn't ship

with the print server. There's a one-time "media" charge of \$199 for the software, which gets you a .25-inch tape, DAT tape, and CD-ROM version of JetAdmin for your operating system. And it only runs on HP-UX, Solaris, and SunOS versions of Unix.

Also, there was no standard LPD support, making the print server less compatible with Unix systems. HP is planning an optional \$99 LPD upgrade.

HP also included setup instructions for Microsoft Windows for Workgroups and Windows NT. These were not nearly as automated as the NetWare and Unix installations, but these OSs are not yet in demand either.

The \$399 price tag for the HP JetDirect EX is slightly misleading, since you might still want the \$99 LPD option or the \$199 JetAdmin for Unix option to get your JetDirect up and to do IP printing. Nonetheless, HP takes the first steps to a friendlier multiprotocol print environment, especially for desktop oriented managers.

► **HP JetDirect EX.** List price: \$399; JetAdmin for Unix, \$199; LPD upgrade, \$99. Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, Continues on page NE19

SUITABILITY TO TASK	
HP JetDirect EX	
Monitoring	EXCELLENT
Compatibility	GOOD
Installation	EXCELLENT
Configuration	EXCELLENT

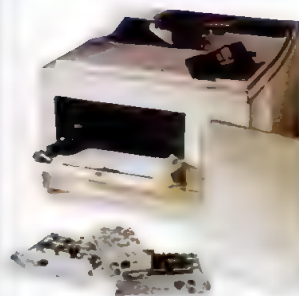
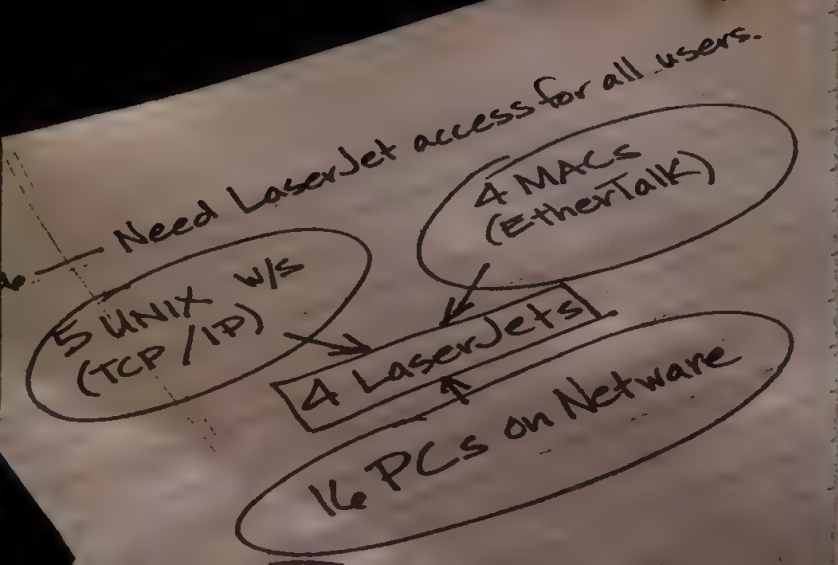
► SUMMARY OF FEATURES

Multiprotocol Print Servers

PC MAGAZINE
NETWORK EDITION
EDITORS' CHOICE

Products listed in alphabetical order	Axis NPS 530/E	Digital Products NetPrint/200	Emulex NetQue	HP JetDirect EX	Intel Netport-Express XL	Lantrenix EPS1-	Microplex M202	MILAN FastPort 3000
■ = YES □ = NO								
List price	\$495	\$995	\$599	\$399	\$599	\$495	\$595	\$595
Protocols supported	EtherTalk, IP, IPX, NetBEUI	EtherTalk, IP, IPX	EtherTalk, IP, IPX, LAT	DLC/LLC, EtherTalk, IP, IPX	EtherTalk, IP, IPX	EtherTalk, IP, IPX, LAT, NetBIOS/NetBEUI	EtherTalk, IP, IPX, NetBIOS/IP	EtherTalk, IP, IPX, NetBIOS/NetBEUI
Ports	One parallel	Three parallel, one 25-pin parallel/serial	1 parallel, one 9-pin serial	One parallel	Two parallel, one 9-pin serial	One parallel, one RJ-45 serial	Two parallel, two 9-pin serial	One parallel, one 9-pin serial
Ethernet frame types	802.2, 802.3, Ethernet II, SNAP	802.2, 802.3, Ethernet II, SNAP	802.2, 802.3, Ethernet II	802.2, 802.3, Ethernet II, SNAP	802.2, 802.3, Ethernet II, SNAP	802.3, Ethernet II	802.2, 802.3, Ethernet II, SNAP	802.2, 802.3, Ethernet II, SNAP
NetWare print modes	PSERVER, RPRINTER	PSERVER	PSERVER, RPRINTER	PSERVER, RPRINTER	PSERVER, RPRINTER	PSERVER, RPRINTER	PSERVER, RPRINTER	PSERVER
Maximum number of NetWare servers/queues	16, unlimited	16, unlimited	128, 254	16, 64	8, 32	Unlimited, 255	16, 32	16, 24
Unix print modes	LPD	LPD	LPD, RCONNECT, RPRINT	Proprietary (JetAdmin)	LPD	LPD, TCPSocket, telnet	Direct Socket, LPD, RSHD	LPD
TCP/IP protocols and programs supported	ARP, BOOTP, FTP, RARP, RTTEL, telnet, TFTP	ARP, BOOTP, ICMP, RARP, telnet	ARP, BOOTP, RARP, telnet, TFTP	ARP, BOOTP, ICMP, IP, LLC, RARP, SNAP, SNMP, telnet, TCP, TFTP	ARP, RARP	ARP, BOOTP, RARP, RTTEL, telnet, TFTP	ARP, BOOTP, RARP, telnet	ARP, BOOTP, ICMP, RARP, telnet
Uses private SNMP MIB	■	□	■	■	□	□	□	□
Type of firmware	EPROM	EPROM	Flash BIOS	FROM	Flash BIOS	Flash BIOS	Flash BIOS	Flash BIOS
Warranty	3 years	3 years	2 years	1 year	3 years	5 years	3 years	5 years

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Multiprotocol Print Servers

CONTINUED FROM NE16

MS 511L-SJ, Santa Clara, CA 95051-8059;
800-752-0900.

Circle 963 on reader service card

Intel Corp.

• NetportExpress XL

Despite its status as the print-server leader, Intel Corp.'s NetportExpress XL is not yet ready for the external multiprotocol print-server environment. Its friendly PC-based management and installation software can't make up for serious performance problems with Macintosh printing and confusing Unix installation.

The biggest problem with the NetportExpress is its EtherTalk printing.

SUITABILITY TO TASK	
NetportExpress XL	
Monitoring	EXCELLENT
Compatibility	FAIR
Installation	EXCELLENT
Configuration	EXCELLENT

When tested from our Quadra 700, the NetportExpress consistently dropped packets. The result was that a single page, which normally printed in 6 to 7

seconds, took 7 minutes. Intel confirmed that the problem existed but only with higher-performance Macs like the 700. The company is working on a software upgrade, flashBIOS, that will solve this problem.

Unix setup was almost impossible, because of poor documentation. Luckily, Intel's technical support people were better versed in Unix installations than their documentation writers, and with their help we were able to get the NetportExpress up and running.

Unix and Mac users may also be disgruntled with Intel's use of the Remote Boot Login (RBL) method to configure the server on start-up. RBL is a proprietary NetWare system designed to allow devices such as print servers to store configuration information centrally on a NetWare server. It requires that a NetWare server be available, even if the print server is only going to be used for IP printing. This is, of course, less of a concern for NetWare-centric sites, no doubt a large customer group for Intel.

Not all is a loss here. Intel, like HP, is more sensitive to the desktop market. Like HP's JetAdmin software, Intel's Windows NetportManager provides powerful print-server management and configuration with a friendly graphical interface. The GUI let us set up the print server and configure ports (two parallel and one 9-pin serial) and other parameters with a few common Windows dialog box actions. Unix and Mac management, however, are unavailable.

The NetportExpress XL is riddled with Unix and Mac problems. Intel needs to do some refining before it is ready to survive in the multiprotocol print-server league with the degree of success it has earned in the PC network-printing market.

► **NetportExpress XL.** List price: \$599. Intel Corp., 5200 NE Elam Young Pkwy., Hillsboro, OR 97124; 800-538-3373.

Circle 964 on reader service card

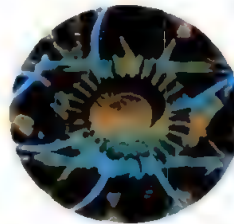
Lantronix

• Lantronix EPS1

The Lantronix EPS1 is the obvious choice if your bottom line is cost. At \$495, the EPS1 supports five protocols and is the only tested print server that

supports a cross-platform management system. Unfortunately, setup, serial port configuration, and Macintosh management snafus make the EPS1 less technically appealing than other print servers tested here.

The EPS1 is the only product here to offer the same server-management inter-



The Lantronix EPS1

is the only tested print server that offers the same management interface on all three platforms.

face on all three platforms—important if you expect to check server status and do print-server configuration from a PC, Unix host, or Mac. The EPS1 uses a login-type program for monitoring and server configuration, which is done by entering command-line instructions. PC and Mac users may not be excited about this interface, a far cry from the HP's JetAdmin, but at least it's consistent.

The EPS1 comes with a parallel and a serial port. The serial port isn't the normal 9-pin D₉-connector found on nearly all of the other print servers tested. Instead the serial port is an RJ-45

Continues on page NE21

• How We Tested

We tested external multiprotocol print servers on three platforms: Unix, NetWare (PC), and EtherTalk (Macintosh). For Unix, we used the SunOS 4.1.3 version of Unix—compatible with the Berkley Software Distribution (BSD)—running on Sun Microsystems' SPARCstation 2. We also looked for System V support using Solaris 2.3, but did not test it. Our NetWare server was a Systempro XL 50 running NetWare 3.12. We tested simultaneous NetWare printing on two Compaq Prolinea 486/33s; each had 8MB of RAM and was run-

ning DOS 6.22 and Microsoft Windows 3.1. For Macintosh printing we used a Quadra 700. All of the workstations were connected using a single 10BaseT Ethernet hub.

Our test-bed printers were an HP LaserJet 4 Plus for PC and Unix printing on the print server's parallel port and an HP LaserJet 4M for Macintosh printing on the print server's serial port (when available). We did PC printing from Microsoft Word for Windows 2.0 and Macintosh printing from Microsoft Word for Macintosh 5.1.

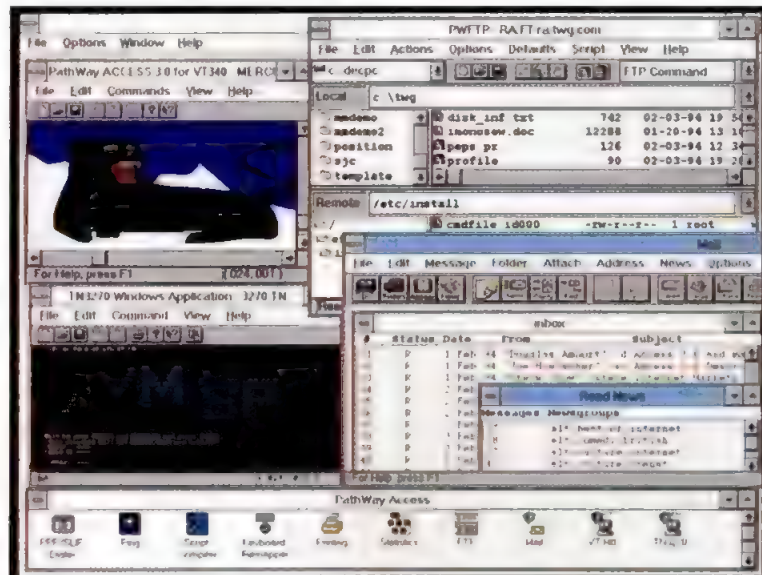
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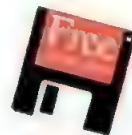
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Multiprotocol Print Servers

CONTINUED FROM NE19

10baseT-like connector. Lantronix supplies both 25-pin male and female D-connector interfaces. The male connector is pinned out (assembled), but the female connector is not, which is a nuisance, especially if you're installing multiple print servers. The EPS1 worked fine on the HP LaserJet 4M printer, but we couldn't get it to work with the HP LaserJet 4 Plus, which uses a 9-pin connector, rather than the 25-pin connector.

In addition to IP, IPX, and EtherTalk, the EPS1 will appeal to existing Microsoft LAN Manager and Digital Equipment Corp. sites with its support for NetBIOS/NetBEUI

and LAT. As the EPS1 didn't come with a setup program, we had to perform NetWare setup manually using PCONSOLE. This worked well, but it was nonetheless less automatic than the setup procedures for MiLAN's ACT, HP's JetAdmin, or Intel's Netport Manager.

Lantronix also did not supply any Unix installation utilities. Generic BSD and System V instructions worked fairly well, but some BSD instructions were left out. Macintosh setup was a snap as usual. Just plug your printer in and it's ready to print. Lantronix only supports EtherTalk on its serial port while other products reviewed here, such as the HP JetDirect EX, support Mac printing on parallel ports.

The EPS1 has greater protocol flexibility than most of the other tested print servers. But it could be improved a bit with more automated Unix and PC installations.

► **Lantronix EPS1.** List price: \$495. Lantronix, 15353 Barranca Pkwy., Irvine, CA 92718; 800-422-7055.

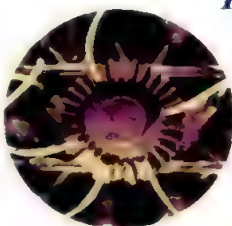
Circle 965 on reader service card

Microplex Systems Ltd.

• Microplex M202

The Microplex M202 is a robust Unix-oriented print server. It offers powerful, hardware-based printer-configuration utilities and a simple procedure for setting up Unix printing.

The routine for setting up Unix's standard LPD printing is rivaled only by HP's



*The Microplex M202 has
a comprehensive status
screen that combines
printer management
and job status in one view.*

proprietary JetAdmin program, which is used by the HP JetDirect EX. Using the NPConfig and EZSetup programs cuts down on the time needed to configure the server: They automatically configured PRINTCAP file information, a process that is done manually when installing most of the other print servers for Unix, including Intel's NetportExpress XL and Emulex's NetQue.

The M202 also simplifies custom printer configuration using Microplex Models. Models let us define parameters such as PostScript and pre- and post-job control strings to ensure proper printing. Similar to the Axis NPS-530/E's logical printers, the M202's Models are stored, letting jobs from any platform take advantage of the configurations.

The M202 print server has ports galore: two parallel and two nine-pin serial. Of the tested print servers, only Digital Products' NetPrint/200 had as many ports.

All of the configuration and monitoring for the print server is done using Microplex's NPSH on-board command language. Like those for the NetQue and Axis NPS-530/E, this language was a bit cumbersome. The M202 did, however, have one of the most comprehensive status screens, combining printer and job status in a single screen.

SUITABILITY TO TASK

Microplex M202	
Monitoring	GOOD
Compatibility	EXCELLENT
Installation	GOOD
Configuration	GOOD

manually. We would have preferred a NetWare equivalent of NPConfig and EZSetup.

The M202's documentation is almost like a TCP/IP textbook, providing some of the best explanations of how IP and the print server work. Thorough explanation of each command was a departure from the terse on-line help provided by such products as NetQue, making configuration and testing a bit easier.

The Microplex M202 print server is great for Unix-intensive shops. Desktop-like installation and monitoring would make the M202 as appealing for the NetWare environment.

► **Microplex M202.** List price: \$595. Microplex Systems Ltd., 8525 Commerce Ct., Burnaby, British Columbia, Canada V5A 4N3; 800-665-7798, 604-444-4232.

Circle 966 on reader service card

MiLAN Technology Corp.

• FastPort 3000

MiLAN Technology Corp.'s FastPort 3000 delivers some of the most powerful, PC-based print-server monitoring tools of all the products tested for this roundup. Its finicky NetWare setup procedure, however, makes it one of the more difficult products of the group to get up and running.

The FastPort includes both a serial and parallel port, and it supports IP, IPX, and EtherTalk, as well as NetBIOS/NetBEUI for Microsoft LAN Manager installations. It also offers one of the most comprehensive NetWare installation and monitoring programs: ACT, Version 1.41. ACT's NetWare-like interface simplifies everything from installing the server to monitoring individual jobs at the port and queue level, information not provided by most of the other tested print servers. ACT's monitoring capabilities were some

Continues on page NE23

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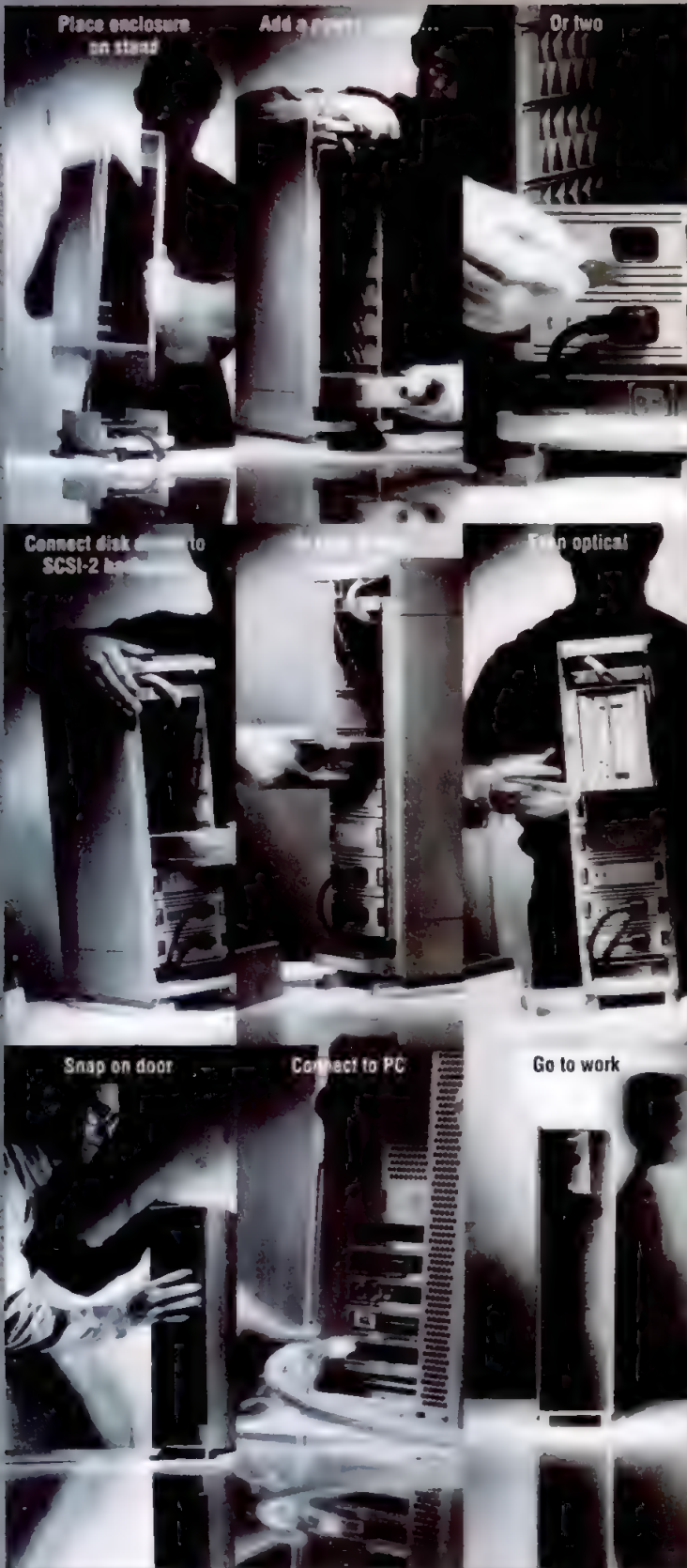
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Multiprotocol Print Servers

CONTINUED FROM NE21

of the best in this group. Unfortunately, ACT suffers from occasional crashes, and it has no monitoring tools for Mac and Unix workstations.

The FastPort is an improvement on standard NetWare queue-monitoring capabilities, because you can specify servers and queues to monitor, thereby reducing queue polling time. It uses a configuration file stored on the server to

SUITABILITY TO TASK

FastPort 3000

Monitoring	EXCELLENT
Compatibility	GOOD
Installation	FAIR
Compatibility	GOOD

assign the servers and queues that it has to monitor. It is also supposed to support conventional logins that check each NetWare server on the LAN to see if

there are any queues to be monitored, a feature we were unable to make work.

MiLAN's FastPort print server does not have a Unix installation routine, but it does have step-by-step instructions for installing the server in BSD and System V servers. These well-written instructions were accurate and straightforward, but a more automated installation system would have been greatly appreciated, especially for NetWare and Macintosh aficionados.

MiLAN rates the FastPort's throughput speed at 50 Kbps at the printer port, adequate to keep up with the graphic and text files we sent to our test-bed, which consisted of a LaserJet 4M and a LaserJet 4 Plus printer.

MiLAN's FastPort 3000 will appeal to NetWare users with its strong configuration and monitoring capabilities at the desktop. More accurate Unix installation documentation would make it less painful for Unix users.

► **FastPort 3000.** List price: \$595. MiLAN Technology Corp., 894 Ross Dr., #101, Sunnyvale, CA 94089; 800-466-4526.

Circle 967 on reader service card

OUR CONTRIBUTORS: TONY POMPILI is a networking consultant and a frequent contributor to *PC Magazine*. JEFFREY D. BAHER, a project leader for *PC Magazine Network Edition*, did additional consulting for this story.

► REMOTE-NODE SERVERS

The Best Just Keep Getting Better

BY STEVE RIGNEY

Microcom and Shiva are simplifying remote communications. The LANexpress and LanRover Plus were strong products before: They received honorable mention and Editors' Choice, respectively, in our latest roundup of remote-node servers ("Extend Your Reach," *PC Magazine*, August 1994). The new versions are even better and easier to install.

Microcom Inc.

• Microcom LANexpress

The Microcom LANexpress, Version 2.0, is about as complete a product as you're likely to see. For \$7,999, the LANexpress comes with eight built-in 28.8-Kbps modems and supports both remote-node and remote-control connections as well as both dial-in and dial-out access. The product also includes expressWatch, a Microsoft Windows-based SNMP management application that has significantly enhanced reporting and statistics monitoring features in the latest release.

The product is available in several configurations, with up to 12 ports for Ethernet or Token-Ring networks. The LANexpress includes NDIS- and ODI-compliant net-

work drivers and works with just about any network operating system (NOS). Unlike the LanRover Plus (reviewed below), the LANexpress does not include client software in the purchase price. Rather, the software is purchased separately and is priced at \$50 per user (vol-

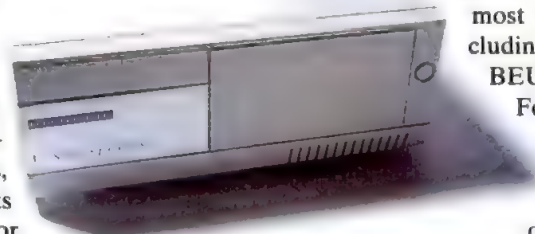
ume discounts are available).

Though the LanRover Plus includes standard 14.4-Kbps serial modems, the LANexpress contains Microcom 28.8-Kbps parallel-port modems. Since the parallel port supports speeds of up to 300 Kbps (as opposed to 115 Kbps on the serial port), Microcom claims that the LANexpress can support higher performance than the LanRover Plus and other devices that use serial modems. We saw no performance advantage during our tests, however, that could be attributed to the parallel-port modems. In fact, when we attached U.S. Robotics 28.8-Kbps modems to the LanRover/E Plus (the Ethernet version of the product), it outperformed the LANexpress.

The expressWatch software, one of the LANexpress's strongest features, now allows you to view over 250 statistics, including packets sent and received, transmission errors, and who is logged on. You can also define filters to customize expressWatch's reporting. The security features available through expressWatch include password protection and remote dial-back.

The LANexpress allows you to connect to your local network using most protocols, including IPX, NetBEUI, and TCP/IP.

For NetWare users, the product lets remote users operate from Novell's NETX and VLM shells, like the LanRover Plus. The



AND IN THIS CORNER: Sporting a host of enhancements, the LANexpress poses a serious threat to the LanRover Plus.

LANexpress is, however, the only product on the market that allows you to use NETX from within Microsoft Windows.

LANexpress prompts users at boot-up for the type of network connection required: local, remote, or none at all.

Continues on page NE24

Remote-Node Servers

CONTINUED FROM NE23

This can save time for users and administrators alike, because separate batch files aren't needed for each type of access.

Overall, the LANexpress 2.0 is an improved version of an already strong product. Software enhancements make the product much easier to manage and use, and it is clear that the LANexpress remains a serious threat to the LanRover Plus for the top of the remote-node-server hill.

► **Microcom LANexpress,**

Version 2.0. List price: With 8 ports, \$7,999; with 10-user license, \$8,499. Microcom Inc., 500 River Ridge Dr., Norwood, MA 02062; 617-551-1000; fax, 617-551-1021.

Circle 968 on reader service card

Shiva Corp.

• LanRover Plus

The first change you'll notice in the Shiva LanRover Plus, Version 3.0, is that it now includes built-in modems for easier installation. Additionally, the product offers optional support for higher-speed connections, such as ISDN or frame relay—the LANexpress does not. While the LanRover Plus with 14.4-Kbps modems (\$8,499) costs the same as the LANexpress with 28.8-Kbps modems, the LanRover Plus includes an unlimited-user license of client software.

Like the LANexpress, the LanRover Plus is available in multiple configurations: two to eight ports for either Ethernet (the LanRover/E Plus) or Token-Ring (the LanRover/T Plus). Also like the LANexpress, the LanRover Plus includes both NDIS- and ODI-compliant drivers and works with most major NOSs. You can purchase the LanRover Plus with either the built-in modems or an equivalent number of high-speed asynchronous ports (\$4,999 with eight ports).

During our tests, we used a LanRover/E Plus with 8 built-in 14.4-Kbps modems and another with 8 U.S. Robotics Courier V.Everything 28.8-Kbps modems (\$545) attached to the asynchronous ports. While the 14.4-Kbps model predictably lagged behind the LANexpress, the 28.8-Kbps configuration outperformed it on most tests.

Though the LanRover Plus includes software only for remote-node access, you can add a third-party product for remote-control connections.

For management, the Shiva Network Manager (SNM) software offers similar features to those provided by expressWatch, but without the extensive statistics. It does allow you to monitor who is currently connected, how long they have been connected, and what

types of modems are attached to the device.

The LanRover Plus also supports AppleTalk and the Apple Remote Access protocols for Macintosh clients—the LANexpress does not. Like the LANexpress, the LanRover Plus supports most network protocols, including IPX, TCP/IP, and NetBEUI.

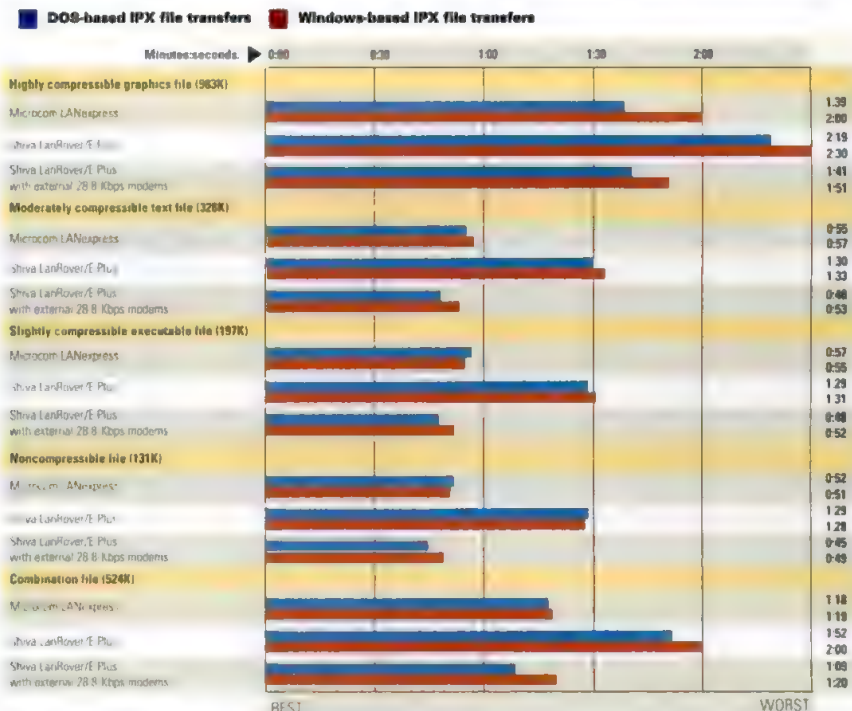
The LanRover Plus, Version 3.0, is another impressive showing for Shiva. Though it may lack some of the management features of the LANexpress, it does support higher-speed connections, as well as Mac clients. Clearly, the LanRover Plus is still a leader in this market—whether it's alone at the top is less clear.

► **LanRover Plus, Version 3.0.** List price: With eight 14.4-Kbps modems, \$8,499. Shiva Corp., Northwest Park, 63 Third Ave., Burlington, MA 01803; 617-270-8300; fax, 617-270-8599.

Circle 969 on reader service card

BENCHMARK TESTS: REMOTE-NODE SERVERS

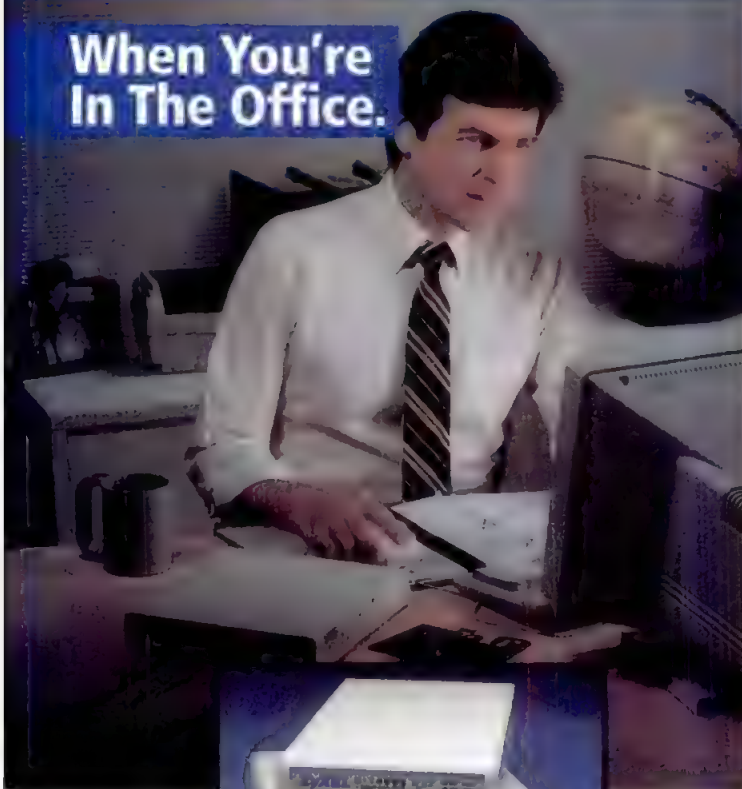
As expected, the Microcom LANexpress with built-in 28.8-Kbps modems outperformed the Shiva LanRover/E Plus with built-in 14.4-Kbps modems on all tests. With external 28.8-Kbps modems, however, the LanRover/E Plus edged out the LANexpress on most tests. Our test-bed consisted of a ZDS Z-Server 433E remote client, an Ares 486-66DX2 NetWare 3.12 server, and a Teltone TLS-5A analog-line simulator. At the client, we used Microcom's DeskPorte FAST 28.8-Kbps modem when testing the LANexpress and U.S. Robotics Courier V.Everything 28.8-Kbps modem when testing the LanRover/E.



We performed file transfers from the NetWare file server to the remote client—DOS-based IPX file transfers using the copy command, and Windows-based IPX file transfers using the File Manager.

There Are Two Times When Modem Reliability Is Critical.

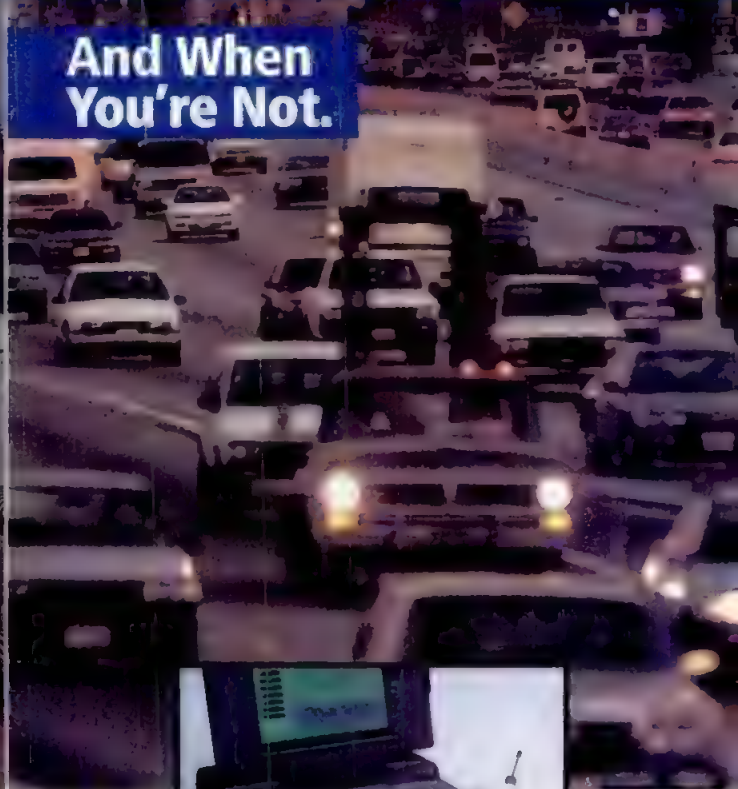
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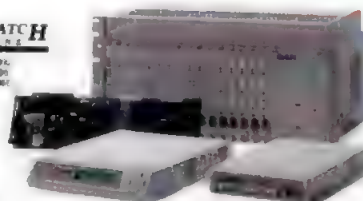
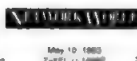
ZyXEL data/fax/voice/cellular modems have more features than other modems of any price—like digitized

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► DEVELOPMENT TOOLS

Visual Power to the People

BY JAY MUNRO

Writing computer telephony and fax applications may seem complicated, but Stylus Innovation has recently introduced a pair of powerful, affordable Microsoft Visual Basic (VB) development tools designed to smooth the learning curve. Visual Voice for Mwave, Version 1.0, and Visual Fax for Intel SatisFAXtion, Version 1.0, work with VB to allow programming veterans and novices alike to build voice mail, fax-back, and order-entry systems with relative ease. Both products are Microsoft Windows-based and require a copy of VB or any development tool that supports VB calls. The only drawback is that each product has very specific hardware requirements.

VISUAL VOICE FOR MWAVE

Visual Voice for Mwave is perfect for users who want to create their own computer telephony and simple fax applications quickly and without hassle. Visual Voice applications work with single telephone lines and can range from voice mail and fax-back programs to interactive voice response (IVR) systems. They work only with voice modems compatible with IBM's Mwave technology. These include IBM's WindSurfer and Best Data Products' ACE.

Visual Voice comprises a set of custom controls (or predefined subprograms) for VB, a workbench utility, and a slew of sample applications. The stars of the show are the *voice*, *fax*, and *test* custom VB controls.

The voice and fax controls provide VB properties that define how your application converses with the phone or fax line. These include items such as *CallerIDDetected*, *RingDetected*, and *LineDropped*. The test control is used to verify that your applications actually work. It allows you to feed simulated input to your application and track the status as the data goes through.

The workbench utility is used to create voice objects, such as prompts for an IVR system, that can be used in your programs. The workbench lets you record and play back voice files in the .WAV file format or in the .TAM (Telephone Answering Machine) format for IBM's Mwave technology, which is the only format that Visual Voice applications can play over a telephone line.

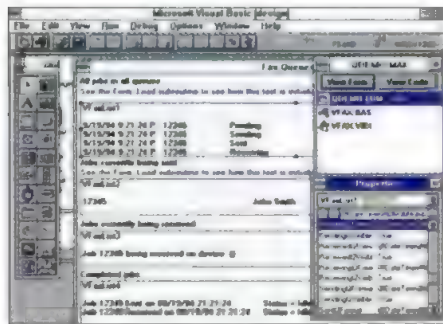
The .WAV files have a purpose, too. They are used by the test control to check your applications. One of the sample programs included with Visual Voice is Virtual Phone, which makes use of the test control to check applications by emulating input from an Mwave board—saving you the trouble of deploying an application before you've tried it out. We found the Virtual Phone very reliable: If our applications worked with Virtual Phone, they worked on a live telephone system as well.

The manual for Visual Voice is excellent. It steps users through installation of the software and also through most of the process involved with creating a voice application. The manual also outlines the files necessary to run Visual Voice applications, which can be distributed free of royalty.

Overall, Visual Voice for Mwave is an easy-to-use and well-documented tool for building computer telephony applications. VB developers of any experience should be able to master the product without much trouble.

VISUAL FAX FOR INTEL SATISFAXTION

Though Visual Voice provides some elementary tools for developing fax applications, Visual Fax for Intel Satisfaxtion, Version 1.0, provides the graduate-level utilities. Visual Fax allows developers to build complex single- or multiline fax applications such as fax routing via e-mail, fax-on-demand, and fax-back systems with very little effort. But while Visual Voice requires a certain *category* of hardware, Visual Fax requires a specific make and model: Intel's Satisfaxtion fax modem.



BUILD YOUR OWN FAX APP: Visual Fax lets you create powerful fax applications.

Like Visual Voice, Visual Fax includes three custom VB controls: VFax, VFaxList, and VFaxPrint. The package also includes a configuration utility and five sample VB fax applications.

You use the VFax control to send and receive faxes as well as to track jobs in five different queues. The VFax control can send faxes in ASCII text, PCX, or .DCX (multipage PCX) file formats. Receiving faxes is limited to .DCX support and requires that you find your own file-conversion utility if you need to change incoming .DCXs into more popular formats.

VFaxList is an enhanced list box control that can be added to your program to monitor fax activity. VFaxPrint gives your applications a professional look and feel. It allows users to send a fax by printing from any Windows application—just as they would with a commercial fax application.

The configuration utility allows you to monitor all installed Satisfaxtion boards along with the I/O port assignments for each. The utility also lets you reassign devices to other I/O addresses and adjust IRQ settings.

As with Visual Voice, VB developers should be able to hit the ground running with Visual Fax for Intel Satisfaxtion. It is a solid, affordable tool for developers looking to create low-cost single- and multiline fax systems.

► **Visual Voice for Mwave, Version 1.0.** List price: \$495. **Visual Fax for Intel Satisfaxtion, Version 1.0.** List price: \$495. Stylus Innovation Inc., One Kendal Square, Bldg. 300, Cambridge, MA 02139; 617-621-9545; fax, 617-621-7862.

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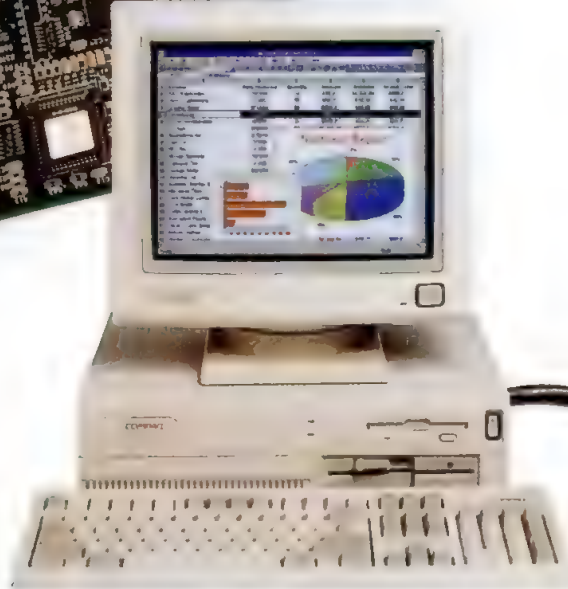


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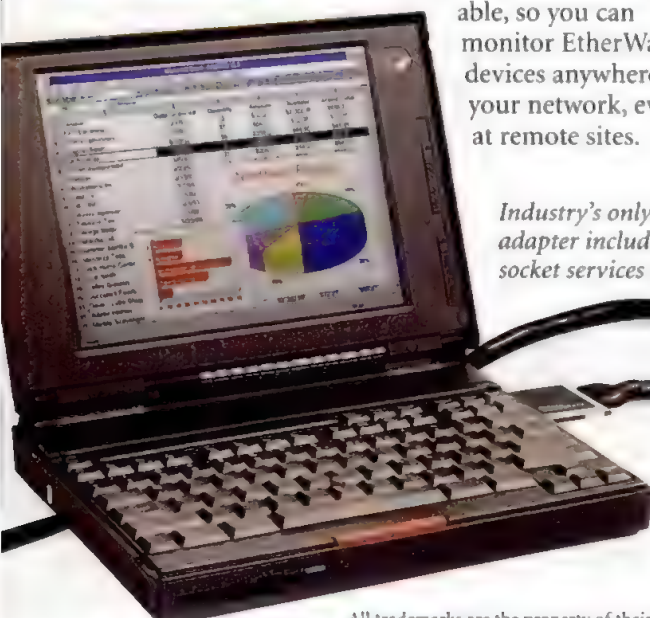


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► LOW-COST ROUTERS

Two Routers for Under Two Grand

BY PADRAIC BOYLE

Two new routers from Compatible Systems and Engage Communications help make the task of connecting remote sites easy and affordable. The MicroRouter 1000R and the ExpressRouter both install quickly and cost less than \$2,000. The choice between the two comes down to protocol support, management, and security.

Compatible Systems Corp.

• **MicroRouter 1000R**

The MicroRouter 1000R (\$1,695) from Compatible Systems can greatly simplify the process of connecting remote LANs. It installs easily, supports all major protocols, is SNMP-manageable from a PC or Macintosh, and provides extensive security features.

The MicroRouter 1000R is a small, modem-size device. It comes with a single Ethernet port that supports 10Base2, 10Base5, or 10BaseT connections (the port automatically senses the proper connection type). You can attach the MicroRouter 1000R to any type of WAN link, including 28.8-Kbps analog, ISDN, frame relay, and fractional T1, using an external CSU/DSU or an ISDN terminal adapter. Unlike the ExpressRouter (see below), these devices cannot be included internally. The MicroRouter's second serial port is dedicated to out-of-band management connections (via a direct serial connection to the router).

We had no difficulty installing the MicroRouter 1000R. In fact, the automatic sensing of the Ethernet port obviated the DIP switch adjustments required with the ExpressRouter.

The MicroRouter SNMP

management software is available for Microsoft Windows-based PCs and Macs. Although it is not available for Unix (unlike ExpressRouter's ExpressView, which is available), it does support SNMP (MIB II) and telnet. This makes the software considerably more powerful and flexible than ExpressView. It also means that you can use MicroRouter 1000R statistics from an existing SNMP management platform. Data gathered by ExpressView, on the other hand, is unusable by SNMP applications. Telnet support makes out-of-band management possible through a command line interface, which is helpful but can be cryptic for many network administrators.

The SNMP statistics tracked by the Windows package, which include packets-per-second and dropped frames, are stored in a dBASE database. These statistics can be accessed from other applications to generate custom reports. The Mac and telnet utilities also track these statistics, but do not maintain databases.

Protocol support is one of the areas where the MicroRouter 1000R shines. Not only does it support TCP/IP and AppleTalk (like the ExpressRouter), it also supports IPX and DECnet. This makes the MicroRouter 1000R suitable for just about

any type of network, particularly for mixed networks that implement multiprotocol traffic. Point-to-Point Protocol (PPP) is used for WAN connections.

The MicroRouter offers a host of security options, including dial-back support as well as support for Challenge Handshake Authorization Protocol (CHAP) and Password Authentication Protocol (PAP). The MicroRouter 1000R also supports Compatible Systems' proprietary Advanced Network Security Protocol (ANSP), which password-protects AppleTalk devices. A "spoofing" feature is also included that limits unauthorized access to specific resources.

Overall, the MicroRouter 1000R has a lot to offer. SNMP management, wide protocol support, and extensive security make this a powerful choice for connecting your remote sites.

► **MicroRouter 1000R.** List price: \$1,695. Compatible Systems Corp., P.O. Box 17220, Boulder, CO 80308; 303-444-9532, 800-356-0283; fax, 303-444-9595.

Circle 971 on reader service card

Engage Communications Inc.

• **ExpressRouter**

Engage Communications' ExpressRouter (\$1,795) is an affordable, flexible multiprotocol router with a range of built-in connectivity options. But it is not SNMP-manageable and does not support IPX or DECnet. For these reasons, the ExpressRouter is unsuitable for some environments.

Like the MicroRouter 1000R, the ExpressRouter is a small device. The model we tested had two Ethernet LAN ports and one asynchronous WAN port (other models offer up to three WAN ports). The ExpressRouter supports the same range of WAN connections as the MicroRouter 1000R. Best of all, you can purchase the ExpressRouter with a built-in CSU/DSU or ISDN terminal adapter, making setup easier for high-speed links. These options add between

Continues on page NE36

► SUMMARY OF FEATURES

Low-Cost Routers

Products listed in alphabetical order

■ YES □ NO

	Compatible Systems MicroRouter 1000R	Engage Communications ExpressRouter
List price	\$1,695	\$1,795
Maximum number of Ethernet ports	1	1
Maximum number of WAN ports	1	3
SNMP support	■	□
Management platforms supported:		
Macintosh	■	■
Unix	□	■
Windows	■	■
Protocols supported:		
AppleTalk	■	■
DECnet	■	□
IPX	■	□
TCP/IP	■	■



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—The Tolly Group

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—PC Week



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data back to your office LAN at the same time. A 1 MB file that took you two minutes to send via LANexpress would take from 12 minutes to *over half an hour* using the other products tested.

The Tolly Group also found that under the stress of these real-world operating loads, LANexpress was the only one that remained stable throughout testing.

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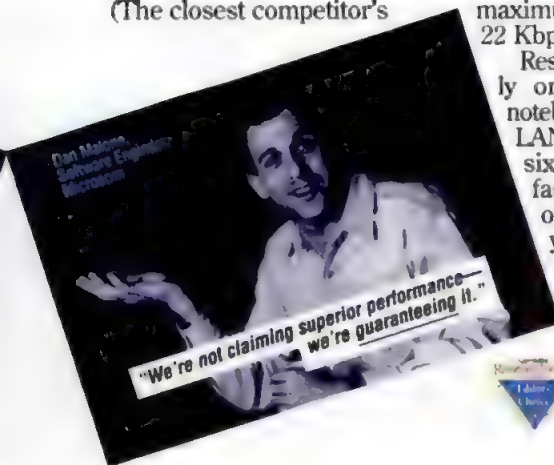
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Bill Gott, Printer Channel Monitor

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Frank Hertz, VARBusiness

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Michael Zeis, Color Business Report

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Low-Cost Routers

CONTINUED FROM NE32

\$500 and \$800 to the initial price of the ExpressRouter.

With only two ports to deal with, we installed the ExpressRouter in about fifteen minutes. We had to adjust some internal DIP switches to configure the Ethernet connection, but otherwise the process was painless.

Once we had the cables connected, we installed ExpressView, Engage Communications' management software, on our Macintosh LC. ExpressView is available for Macs and Unix, but the Windows version was not yet shipping at press time. ExpressView does not support SNMP, but it does provide a decent interface to some basic router statistics, such as port status. Express-

View can only be used for in-band management (from a network client). The MicroRouter software offers both SNMP management and optional out-of-band management.

The ExpressRouter supports TCP/IP and AppleTalk LAN protocols but does not support IPX or DECnet. Though DECnet is popular, IPX is everywhere; lack of support for such a widespread protocol could severely limit the ExpressRouter's appeal. Engage Communications may add IPX support by the end of this year, but no definite plans are in place. For WAN connections, the ExpressRouter uses PPP or frame relay.

The ExpressRouter offers decent security, based primarily on password protection and Network Cloaking (similar to the MicroRouter's spoofing feature), which can make specific segments and resources

invisible to unauthorized clients.

Although the vendor claims that the ExpressRouter's external power supply eliminates the need for a fan, the product generates a significant amount of heat. We recommend that you place the router in a well-air-conditioned room—and monitor it closely.

The ExpressRouter is affordable, simple to install, and offers a wide variety of WAN link options. But the lack of support for IPX and SNMP management weighs heavily against it and could force you to look elsewhere for a low-cost router.

► **ExpressRouter.** List price: *Tested configuration, \$1,795.* Engage Communications Inc., 9053 Soquel Drive, Aptos, CA 95003-4034; 408-688-1021; fax, 408-688-1421.

Circle 972 on reader service card

► BULLETIN BOARD SOFTWARE

Mustang Goes Wild On-line

BY PADRAIC BOYLE

If you're looking to set up your own electronic bulletin board service (BBS), look no further than Mustang Software's new Wildcat! BBS Suite, Version 4.0. This latest version of the popular BBS package adds several new features and tools to assist system operators (sysops) in creating and maintaining customized BBSs. Some of these features, however, can be confusing to users who are unfamiliar with BASIC programming and multiplatform e-mail.

The Wildcat! BBS Suite (\$999) comprises several utilities, including Multiline Platinum BBS, which is the heart of the system and the software that actually runs your BBS. Also included are wcCODE, a proprietary programming language; wcGATE, which provides links to external e-mail systems; wcPRO, which generates reports on the status of the BBS; and wcFAX, which adds fax-on-demand capabilities to your BBS.

The entire Wildcat! suite is very easy to install. Thanks to the default configuration, we had a BBS up and running in



CUSTOM DESIGN: Wildcat! BBS Suite lets you setup your own BBSs, complete with graphics.

just a few minutes. Of course, you'll probably want to change the settings to give your BBS a customized look and feel.

Once we got used to the special key combinations required to navigate the Multiline Platinum interface, we had no trouble altering the appearance of our BBS by adding menus, graphics, and even mouse support.

Wildcat!'s wcCODE is a BASIC-like language that allowed us to add custom applications such as order forms to our BBS. This is a very powerful feature of Wildcat!, particularly for those looking to conduct business on-line, but it can be

very intimidating and confusing for users with little or no knowledge of programming.

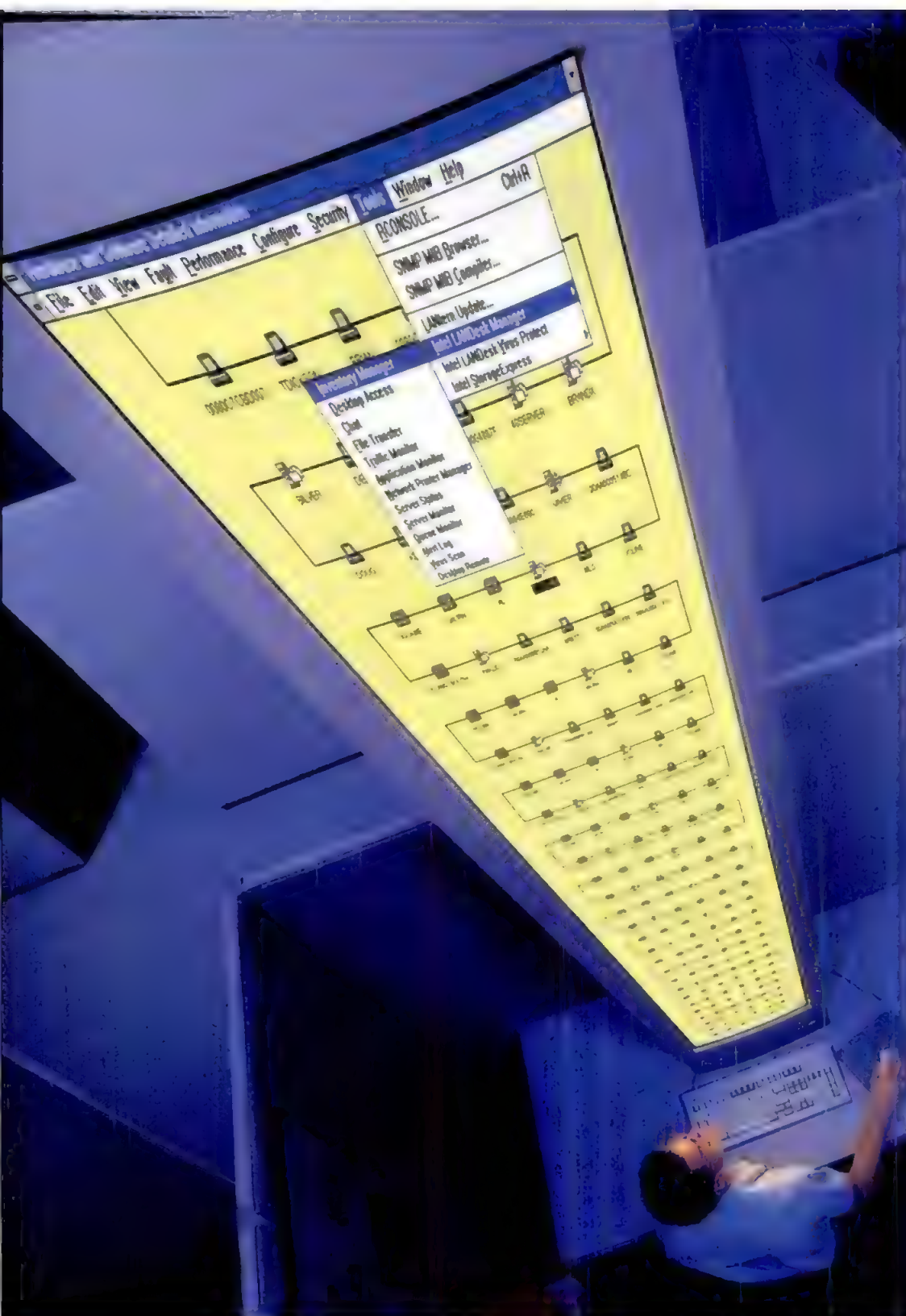
The wcGATE utility allowed us to link our BBS to several popular mail transport services, such as Novell's Message Handling Service (MHS) and Unix-to-Unix Copy Program (UUCP). Of course, additional software is required to access these services. A program is included with Wildcat! that can dial up Unix hosts to provide the UUCP support, but we needed a copy of MHS 1.5 for MHS access. If you're not already familiar with these e-mail systems, you may have a difficult time with wcGATE.

We especially liked wcPRO, which allowed us to generate reports and manage data on users, files, and messages on our BBS. Wildcat! also provides a fax-on-demand utility (wcFAX), which sends faxes in response to users' on-line requests, an on-line chat feature, and a .GIF viewer.

Wildcat! BBS Suite, Version 4.0, is a powerful set of tools for those sysops interested in setting up customized BBSs. Some of the features are complicated, but that is the trade-off for Wildcat!'s power.

► **Wildcat! BBS Suite, Version 4.0.** List price: \$999, Mustang Software Inc., 6200 Lake Ming Rd., Bakersfield, CA 93306; 805-873-2500; fax, 805-873-2599; BBS, 805-873-2400.

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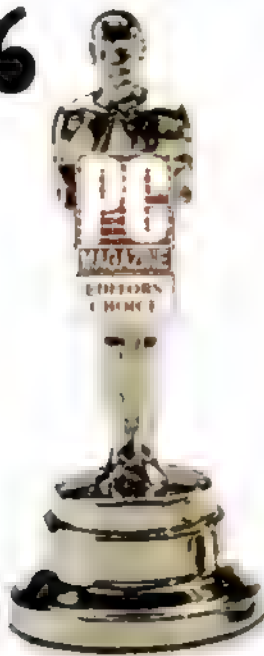
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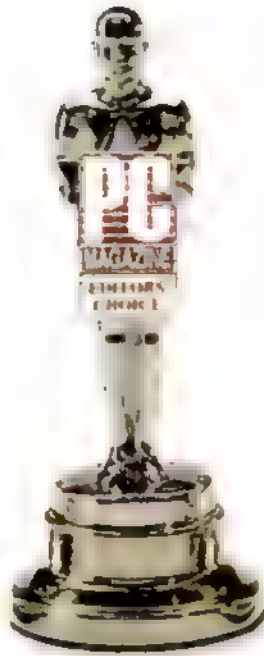
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► MANAGEMENT UTILITIES

Avanti Takes NetWare to Task

BY ED TITTEL

Caring for a NetWare server can be a royal pain, especially when you have to manage a lot of NLMs. With TaskMaster, Version 1.01, Avanti Technology becomes the latest in a wave of vendors to offer a remedy. This DOS-like scripting language allows you to automate the loading and unloading of NLMs and other repetitive NetWare tasks, and should be easy to learn for anyone who has worked with DOS batch files.

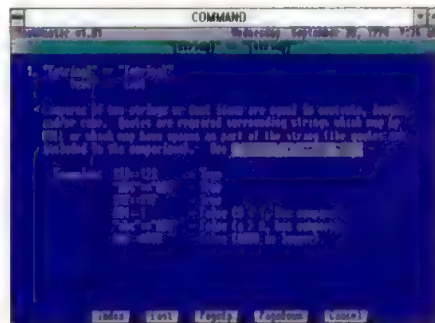
The market for this type of scripting utility is growing every day, and TaskMaster (\$395 per server) faces an uphill battle against existing products. Knochall's NLMerlin (see Network Edition, First Looks, December 21, 1993) and Simware's REXXware (see Network Edition, First Looks, May 17, 1994), for example, both utilize enhanced versions of standard languages (BASIC and REXX, respectively), and might be easier to learn for DOS novices. Also, NLMerlin allows you to manage jobs on clients as well as servers, and both NLMerlin and REXXware are

Microsoft Windows-based. But we found TaskMaster's DOS-like language very easy to learn and much less rigid than either of these utilities.

TaskMaster comprises an NLM and a DOS-based utility that runs on any client. The DOS-based TaskMaster utility is used to browse, schedule, and test scripts, which are written with a third-party text editor. These scripts can handle any manner of NetWare job, such as running a network backup utility at a certain time, then unloading it when the job is complete to

free up server memory. Both components are easy to install, and a brief but adequate manual is included to help with any problems you might encounter.

If you've ever written a DOS batch file, the TaskMaster language will be very familiar. If you haven't, TaskMaster might pose a challenge, despite the extensive on-line help and sample scripts. The format and syntax of TaskMaster's script language are nearly identical to DOS. Though some might consider that a problem, we found it considerably easier to master TaskMaster's DOS-like language than a less familiar programming language like REXX.



HELPING HAND: TaskMaster includes extensive on-line help for smoothing the learning curve.

Although you write the scripts with a third-party utility, you can launch an editor from TaskMaster's shell. This allows you to take advantage of the product's help libraries while still working in the editor.

Through a series of predefined envi-

ronment variables (which are like those defined by a DOS Set command, such as PATH), TaskMaster scripts can access information from the NetWare 3.x bindery or from NetWare Directory Services (NDS), for NetWare 4.x environments. In addition, TaskMaster supports up to ten user-defined environment variables, which you can set to a particular server's name or a type of file.

TaskMaster includes two key features that are particularly useful for task automation. The first is a set of *scan* func-

tions that read information from the server's console or from an ASCII input file. The values that are scanned can be compared to predefined settings and in turn used to control script behavior. For example, an error on the server could trigger a TaskMaster script to log all server console output. You could even use the scan function to search your NetWare volumes to find and delete all copies of DOOM.EXE to prevent unauthorized playtime on the network.

The product's second key feature is a *keyin* function, which allows a script to simulate keyboard input for NLMs or the NetWare console. This can be used to automate simple tasks, such as loading an NLM by sending the proper com-

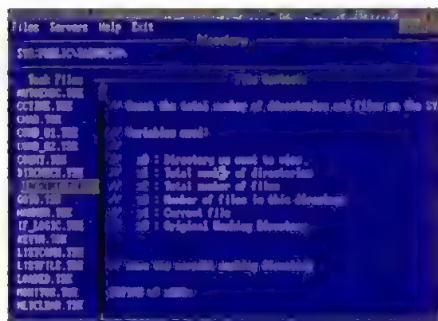
mand to the server. It can also be used to combat the most serious of all NetWare errors: ABEND. Since the TaskMaster NLM continues to run even after an ABEND error locks the server, you can use keyin to send a Ctrl-Alt-Del key combination to the server to reboot.

Finally, TaskMaster's scheduling abilities include both date- and interval-based triggers. Date triggers can be set to the date and time of your choosing. Interval triggers are those that launch a script after a period of days, hours, or even minutes. For example, you could modify the backup script mentioned above to launch every 24 hours, regardless of the date.

TaskMaster is a highly workable utility for automating network tasks. Because of its strong resemblance to the DOS batch language, most NetWare administrators should find TaskMaster a worthwhile addition to their arsenal of utilities that is easy both to learn and to use.

► **TaskMaster, Version 1.01.** List price: \$395 per server. Avanti Technology Inc., 13492 Research Blvd., #120-271, Austin, TX 78750; 512-335-1168; fax, 512-335-7838.

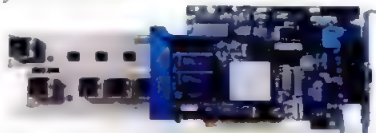
Circle 973 on reader service card



LEARN BY EXAMPLE: Several sample scripts are included with TaskMaster.

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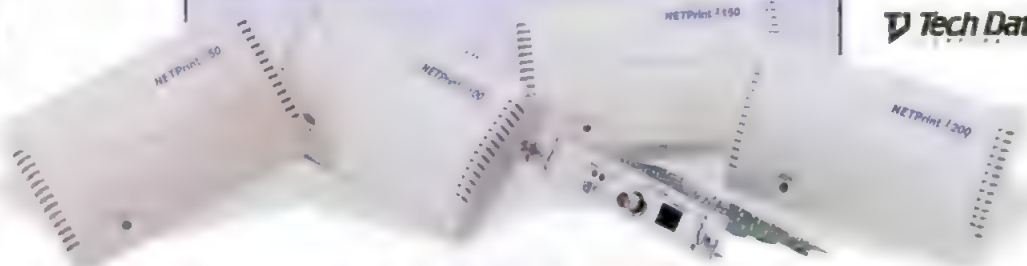
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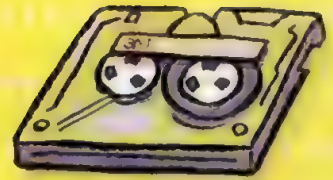
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3M *Reliability*

News of announced network products and upgrades

By Vicki B. Jacobson

NEW

LightStream Readies ATM, Round Two

By integrating LAN services into its second generation ATM switch, **LightStream Corp.** hopes to move ATM into the mainstream market. The LightStream 2020 integrates LAN bridging and routing for Ethernet and FDDI with its ATM switching.

Inherent to the switch is a conglomeration of architectures: The RouteStream Internetworking Architecture handles performance through hardware-based bridging, routing, filtering, broadcast control, frame relay, and frame forwarding. The VirtualStream Global Virtual LAN Architecture allows the network manager to create geographically dispersed LANs. The ControlStream Traffic Management Architecture is a suite of functions designed to reduce traffic and increase available bandwidth. Lastly, StreamView Network Management Systems are another suite of applications that provide SNMP management. The management apps can be used alone or with SNMP platforms such as NetWare Management System or HP OpenView.

The switch supports varied LAN, WAN, and ATM interfaces, such as a two-port FDDI card, two-port T3 interface, OC-3c interface, and eight-port Ethernet and serial cards.

► **LightStream 2020.** List price: \$21,900 to \$300,000. LightStream Corp., 1100 Technology Park Dr., Billerica, MA 01821; 508-262-1000.

Circle 952 on reader service card

NEW

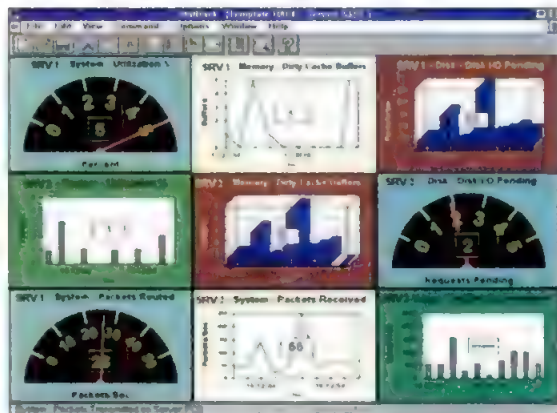
Frye Emphasizes Interoperability in Management

Frye Computer Systems' new The Frye Network Management Platform (FNMP) for Windows adds Windows support to its leading network management platform. FNMP is designed to link into and share information with other popular network management platforms, such as HP OpenView, NetWare Management System, and SunNet Manager. FNMP also supports management standards, such as SNMP, with future support planned for the upcoming Desktop Management Interface.

The platform will incorporate a suite of Windows applications that can work as standalone products or in conjunction with each other. The Frye Network Management Platform for Windows—Statistics Display Rack, Version 1.0, for NetWare (StatRack) is the first available.

► **The Frye Network Management Platform for Windows—Statistics Display Rack, Version 1.0.** List price: \$295; \$195, each additional server license. Frye Computer Systems Inc., 19 Temple Pl., Boston, MA 02111; 617-451-5400; fax, 617-451-6711.

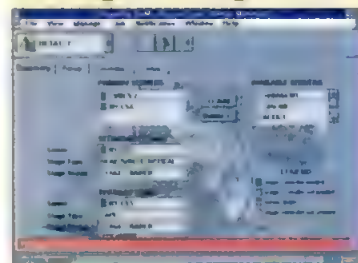
Circle 953 on reader service card



RACK 'EM UP: StatRack displays key server and node stats.

HOT PROSPECT

Cheyenne Advances Storage Management



If your network is overrun with data, **Cheyenne Software's** Hierarchical Storage Manager (HSM), Version 1.0, may be the answer. Designed for NetWare 3.11, 3.12, and 4.x servers, HSM brings the automated storage management typically associated with mainframe environments to large, distributed networks.

HSM is based on a client/server technology in which old files and data are intelligently moved to other media (disk, optical, or tape). Network administrators can set up parameters for moving data and managing storage. Parameters can include hard disk utilization or file usage and age.

HSM 1.0 supports DOS, Macintosh, Microsoft Windows, and Unix clients without the need for a TSR. The software can also be loaded across multiple servers within a network.

► **Cheyenne Hierarchical Storage Manager, Version 1.0.** List price: Base package, \$6,995. Cheyenne Software Inc., 3 Expressway Plaza, Roslyn Heights, NY 11577; 800-243-9462, 516-484-5110; fax, 516-484-3446.

Circle 951 on reader service card

NEW

Proteon Commits to Internetworking

Proteon, a company known mostly for its presence in the Token-Ring market, has announced a slew of new Ethernet products: switching hubs, intelligent stackable hubs, and adapters. The ProNET/E line is designed to address the current needs of networks with mixed topologies and to ready them for the move to high-speed technologies such as 100VG-AnyLAN and ATM.

The ProNET/E Ethernet adapters support a wide variety of buses (EISA, ISA, PCI, and PCMCIA), drivers (NDIS, NE2000, and ODI), media types (BNC and 10BaseT), and operating systems (Microsoft LAN Manager and Windows for Workgroups, NetWare, and VINES, among others).

The ProNET/E Series/80 Ethernet Intelligent Hubs range in size from 8- and 12-port 10BaseT models to a 12-port 10BaseT model with management. Both 12-port hubs support up to 168 nodes.

The ProNET/E Series/80 Ethernet Switching Hubs feature either 8 or 16 ports and SNMP support. The 16-port model also features high-speed connections for FDDI.

► **ProNET/E Ethernet adapters.** List price: \$69 and up. **ProNET/E Series/80 Ethernet Intelligent Hubs.** List price: \$299 and up. **ProNET/E Ethernet Switching Hubs.** List price: \$3,799 and up. Proteon Inc., 9 Technology Dr., Westborough, MA 01581-1799; 508-898-2800.

Circle 954 on reader service card

NEW

VideoLabs Goes One-on-One

VideoLabs has announced its new VideoPlex 301 Transceiver for sending full-motion video with audio over existing telephone lines. The one-on-one videoconferencing system can be extended to a radius of 3,000 feet, without the need for repeaters using standard unshielded twisted pair wiring. Bidirectional transmission can be established with another room equipped with a transceiver, camera, microphone, speaker, and monitor. The transceiver features broadcast-quality video at up to 30 frames per second.

► **VideoPlex 301 Transceiver.** List price: \$695. VideoLabs, 10925 Bren Rd. East, Minneapolis, MN 55343; 612-988-0055.

Circle 955 on reader service card



ONE-ON-ONE: VideoLabs provides full-motion video with audio.

NEW

Cisco Delves into Remote Market

With five new lines and over 50 new products, **Cisco Systems** is settling nicely into the remote-access market. The onslaught includes new hardware as well as enhancements to existing products.

New products include the Cisco AccessPro PC Card and the Cisco 1000 LAN Extender. The AccessPro is a router on a card designed for Microsoft Windows NT Advanced Server PCs. The LAN Extender is a two-port device that ships with switching software. Cisco is also adding three new models to its Cisco 2500 line. The routers will add another WAN connection, bringing the total to two.

► **Cisco AccessPro PC Card.** List price: \$1,995. **Cisco 1000 LAN Extender.** List price: \$1,595. **Cisco 2500.** List price: \$2,995 and up. Cisco Systems Inc., 170 W. Tasman Dr., San Jose, CA 95134-1706; 415-326-1941; fax, 415-326-1989.

Circle 956 on reader service card

BRIEFS

NETWORK MANAGEMENT

Alantec Corp. announced a graphical-based management package for its line of intelligent switching hubs. **PowerSight** (\$4,995) allows network managers to control hub, bridge, and router features, manage bandwidth distribution and allocation, monitor segment utilization, and create virtual LANs of their PowerHub. Statistics can be viewed in tabular or graphical formats from a single location. 408-955-9000.

FORE Systems announced the second release of ForeView Network Management Software for its ForeRunner ATM switch networks. Version 2.0 (\$4,995) provides a channel-tracer feature that shows how virtual circuits are routed through the ATM network. Network managers also gain expanded tracking utilities, including ones that report usage and error statistics. 412-772-6600; fax, 412-772-6500.

ADAPTERS

Boca Research's new 16-bit ISA 10BaseT adapter (\$59) supports the standard NE2000-compatible drivers. The BocaLANcard 2000+ features a jumperless software-configurable design, allowing users to select features such as interrupt channels, memory address, I/O address, and LED indicators through the software itself. 407-997-6227; fax, 407-997-0918.

SysKonnect added a new family of ATM NICs to its line. The adapters are designed for the EISA, PCI and SBus platforms. The SK-NET ATM SBus series (\$1,395 to \$1,895), the SK-NET ATM PCI series (pricing to be announced) and the SK-NET ATM EISA series (\$1,695 to \$1,995) use the SONET/SDH transport for speeds up to 155 Mbps. 800-752-3334.

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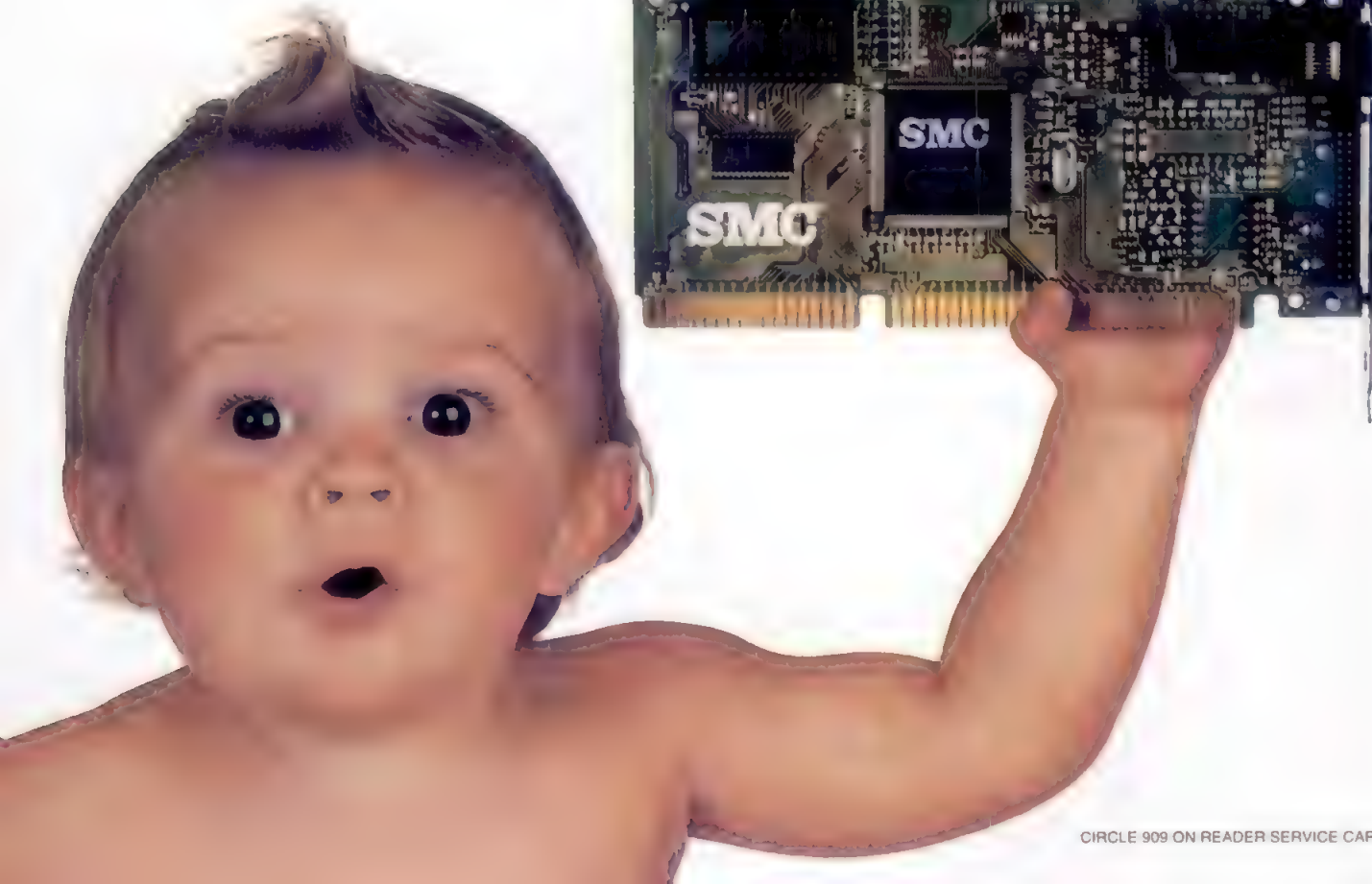
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NEW

Synergy Launches Communications Kit

With its software/hardware bundle, **Synergy Solutions** turns any networked PC into a communications server. The Synergy Comm Server Kit consists of communications server software—Modem Assist PLUS—and the SS-554 Four-Port Serial Card.

Equipped with Modem Assist PLUS, Version 3.0, the communications server supports up to 16 ports for modem sharing. Users can dial out with Windows fax or communications software or DOS communications software that supports INT14 or NASI. The PC-turned-communications-server also supports dial-in services for its remote users using a remote-control package.

► **Synergy Comm Server Kit.** List price: \$795. Synergy Solutions Inc., 2150 S. Country Club, #1, Mesa, AZ 85210; 602-545-9797; fax, 602-545-9827.

Circle 957 on reader service card

NEW

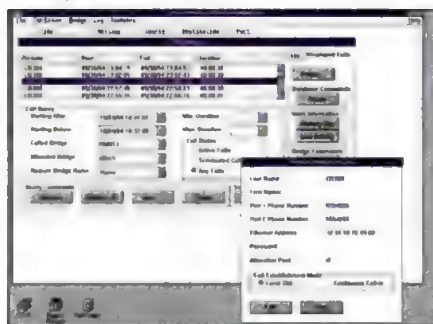
Combinet Brings ISDN Users Everywhere

Combinet expands its network management horizon with **Everyware Connection Manager**, an application developed for remote-access ISDN networks. Network administrators can manage from 20 to over 10,000 remote users over ISDN or Switched 56 lines. From a single location, the administrator can monitor, configure, and maintain the security of the network.

Data logging and reporting is available via **Connection Manager** by origin, destination, duration, and connection status of every call. And instead of traveling to remote sites, network administrators can set up, download software, and perform diagnostics remotely. Security features include a centralized database for caller authentication, records of unauthorized dial-up attempts, and password protection. **Connection Manager** runs on a dedicated PC using a Microsoft Windows interface.

► **Everyware Connection Manager.** List price: \$895. Combinet Inc., 333 W. El Camino Real, Sunnyvale, CA 94087; 408-522-9020; fax, 408-732-5479.

Circle 958 on reader service card



REMOTE CONTROL: With **Connection Manager**, administrators can manage remote users over ISDN.

NEW

Retix Drops Price of Remote Access

Two new remote-office routers from **Retix** offer LAN to WAN connectivity at low cost. The RouterXchange 7000 RX 7100 family comes complete with hardware, IP and IPX routing software, WAN interfaces, and cables, providing an all-in-one remote solution that's plug-and-play.

Products in the RX 7102 features one Ethernet port and one WAN port; the RX 7103 adds another WAN port. Both routers feature simultaneous routing of IP and IPX, bridging of all protocols, and four-to-one data compression. Network managers can use the RetixVision graphical management system, a third-party SNMP management application, or telnet to manage to routers.

► **RouterXchange 7000 RX 7102.** List price: \$1,795. **RouterXchange 7000 RX 7103.** List price: \$2,295. Retix, 2401 Colorado Ave., Santa Monica, CA 90404-3563; 310-828-3400; fax, 310-828-2255.

Circle 959 on reader service card

BRIEFS

HUBS

Xyplex added two products targeted at the branch office to its line of hub/routers. The Network 3800 Hub Router (\$2,995) is designed for smaller sites and features one Ethernet and one WAN connection, as well as 12 managed 10BaseT nodes. For small to medium-size sites, the company announced the Network 3850 Hub Router (\$3,295). The 3850 includes one Ethernet and two WAN connections in addition to the 12 managed 10BaseT nodes. Both models support AppleTalk, IPX, and TCP/IP, concurrent Spanning Tree bridging, frame relay, Switched 56, and ISDN BRI. It also offers optional support for DECnet, OSI, and X.25. The hub/routers can be managed from a central site using Xyplex's own SNMP management package, ControlPoint, or a third-party SNMP management device. 800-338-5316.

Cabletron Systems announced a new module for its MMAC-Plus hub—the Ethernet MicroLAN Extension (\$9,995). The three-segment module integrates bridging, routing, and switching. Using the module, network managers can control network traffic by reducing the number of users or servers per LAN segment. Initially, the module will support bridging and routing; SecureFast switching (Cabletron's packet-forwarding switching technology) will be available in the second quarter of 1995. 603-332-9400.

Optical Data Systems announced a new line of FDDI modules for its Infinity intelligent hubs. The modules (\$3,595 to \$23,995) quadruple the capacity of FDDI by supporting four independent dual-attached FDDI rings with throughput of up to 400 megabits per second. 214-234-6400; fax, 214-301-3893. □



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August 1994

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Wireless: The Next Generation

Can faster, more accessible networks make wireless communications a way of life?

By Steve Rigney

Wireless data services are designed to help users break free from cables. But until now they've all suffered from slow speeds, lack of availability, or limited applications. All that may soon change thanks to a series of recent developments. New spread-spectrum technology, wider availability of Cellular Digital Pocket Data (CDPD), and a faster Ardis network should all make wireless a more reliable and accessible technology.

The latest development is Ricochet, the new wireless network from Metricom (408-399-8200) that offers a blistering maximum raw-data rate of 77 kilobits per second (Kbps). Ricochet is a frequency-hopping, spread-spectrum radio network, similar to those utilized by wireless LAN adapters but with far greater performance and range (more than a mile) due to a more powerful on-board transceiver. However, Ricochet isn't mobile-user-friendly: It doesn't work if you're travelling faster than 6 mph.

The key features of Ricochet are the Metricom wireless modem (\$495) and the stationary transceivers. The modem attaches to any PC and uses the Point-to-Point Protocol (PPP). The backbone of the network is made up of the stationary transceivers, which attach to utility poles or similar points throughout a metropolitan area. Each transceiver provides its own service area with a radius of about a mile. When a transceiver is attached to a telephone switch, Ricochet users will be able to access on-line resources by dialing

standard telephone numbers.

Ricochet is only available in the San Francisco area right now, but Metricom plans to install transceivers in more cities as customer demand builds. Ricochet is a subscription-based service, with prices starting at \$9.95 per month.

While Ricochet offers high-performance, CDPD offers the advantage of widespread vendor support and rapidly increasing availability. Unlike Ricochet, CDPD is not a subscription-based wireless network. Rather, it is a standard that supports data transmissions over existing cellular links by exploiting unused cellular channels.

Since CDPD uses the same switches as regular cellular service, the only hardware requirement is a CDPD modem. Vendors that are developing CDPD modems include IBM, Motorola, Pacific Communication Services (PCSI), and Sierra Wireless. CDPD is currently available in Baltimore, Chicago, San Diego, Seattle, and Washington, D.C. By early 1995, availability of CDPD should more than double to other large markets.

The raw-data rate for CDPD is 19.2 Kbps, which is slower than that of Ricochet but suitable for most applications. Monthly charges for CDPD are expected to range

from \$15 to \$120, depending on usage.

Not to be outdone by upstarts like Ricochet and CDPD, Ardis (708-913-4409) recently began upgrading its wireless network to support a raw-data rate of 19.2 Kbps (up from a scant 4.8 Kbps). Ardis, which was introduced by IBM and Motorola in the late 1980s, is the nation's oldest, most widely available wireless network (35,000 subscribers in roughly 400 U.S. cities). Ardis utilizes *packet radio* technology, which transmits data using an enhanced version of the X.25 protocol. The service is built around a system of over 1,300 radio towers connected by a T1 backbone. Users require a packet radio modem and

► SUMMARY OF FEATURES

Wireless Networks

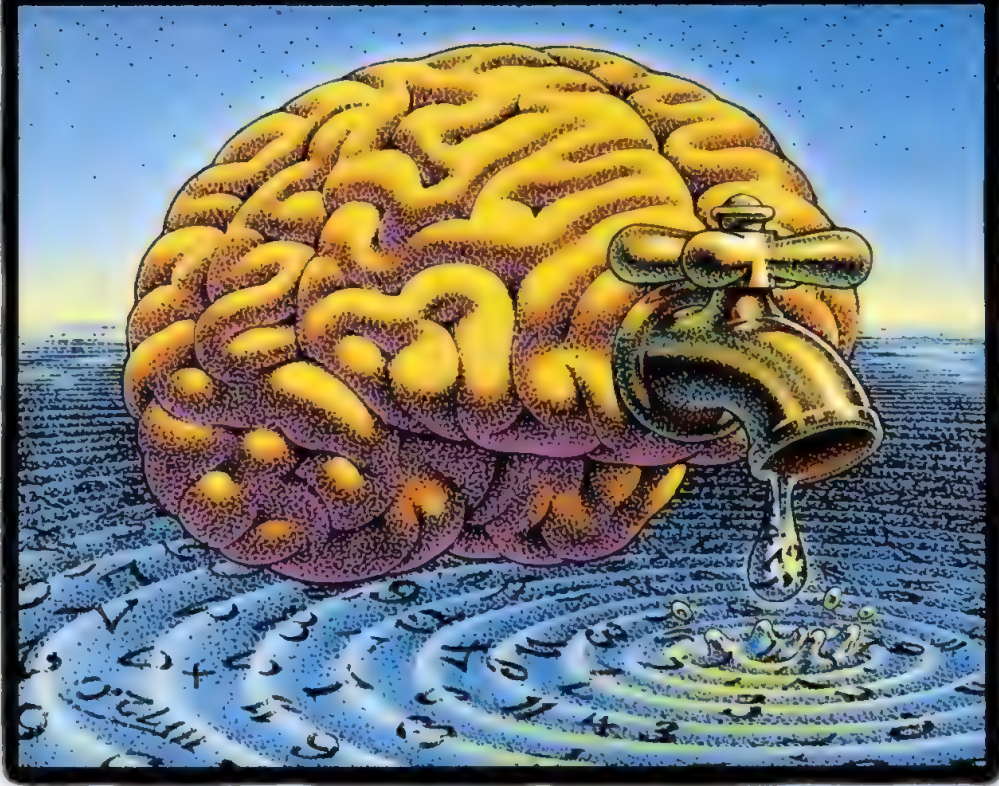
In alphabetical order by company	Ardis	CDPD	Ricochet
■ = YES □ = NO			
Price per month	\$35.00 to \$150.00*	\$15.00 to \$120.00*	\$9.95 to \$29.95
Transport	Packet radio	Cellular	Frequency-hopping spread-spectrum radio
Maximum raw-data rate	19.2 Kbps	19.2 Kbps	77 Kbps
Number of metropolitan areas served (as of 9/94)	400	5	1
Third-party support (as of 9/94)			
Hardware	IBM, Itronic, Motorola	CMI, IBM, Motorola, PCSI, Sierra Wireless	None (proprietary)
Software	RadioMail and custom applications	Any TCP/IP communications software	Any communications software
Pros	Wide availability	Wide third-party support	Fast
Cons	Limited applications	Limited availability	Limited availability

* Pricing depends on usage

specialized software to access the Ardis network.

Ardis was originally limited to e-mail, specifically with applications like RadioMail (RadioMail Corp., 800-597-6245). But with the performance boost and a large installed base, Ardis could evolve into a much more versatile wireless service. Pricing for Ardis, which like Ricochet is subscription-based, is typically between \$35 and \$150 per month, depending on usage. □

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Wanted: A Leader for the Video Age

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The videoconferencing market is sitting on a gold mine. People are itching to try out this latest technology. I too fell susceptible to the urge and went looking for such a system for my office.

My advice? Go ahead, but don't expect too much. The desktop videoconferencing systems just aren't up to snuff. There are lots of good reasons why videoconferencing today is little more than a toy. Some obvious reasons are cost, fragmented functionality, and little interoperability.

But the real problem is more subtle. To capitalize on this gold mine, the market needs leadership that can define the right standards and the right vision for the industry. Vision and standards mean an awareness of the real videoconferencing market and a clear definition of a video architecture to stimulate the market.

Sure there are videoconferencing standards such as H.320 (international set of wide area audiovisual standards) and px64 (a wide area video compression standard) that are backed by the traditional telecom vendors like AT&T, Compression Labs Inc. (CLI), MCI, NEC, PictureTel Corp., and VTEL Corp.

But these standards are generally found only in more expensive videoconference-room systems. They don't address three core issues: transport independence, multipoint use, and an application programming interface (API) for independent software vendors (ISVs).

Transport independence is key. Much of the interest in videoconferencing comes from Intel's ProShare, which while interesting is limited to ISDN lines. There are only so many ISDN lines in operation today, while there are about 40 million desktop PCs on LANs. The bottom line: Today, video service delivered over LANs is a larger potential market than ISDN. ISDN is important in communications with businesses and in small offices, but it must work with LAN-based videoconferencing.

Another problem is scale. Current standards are geared toward expensive videoconferencing rooms. The new standard would offer an architecture that includes



*By Nick
Lippis*

interfaces from big conference-room systems to low-end PC-based codecs.

The standard would address a second problem of scale: multipoint access. Currently, most videoconferencing systems available for the PC are meant for a conversation between two sites. But if you are like me, you'll want and need to set up multipoint videoconference calls.

Not only does the architecture need to provide interfaces among a variety of video equipment and multipoint access but, most important, APIs must exist to integrate videoconferencing with enterprise network services and

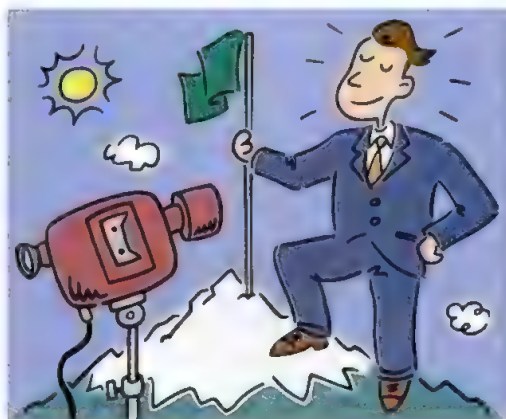
desktop apps. Crucial to desktop videoconferencing success is scalable collaboration software that extends existing desktop and enterprise services into the virtual-meeting-room paradigm. To meet this end, video must be distributed over the enterprise internet with the open API for collaboration on software development.

With no single company dominating all forms of video, partners need to develop a single consortium. There is an Intel-driven consortium, but I don't believe this model is likely to succeed. The reason is that the video market transcends the PC market. In the PC market, Intel and Microsoft can dictate architecture, but in video there are firms larger than even these giants, such as the carriers AT&T, MCI, Sprint, and the RBOCs. These carriers don't kowtow; the only way to bring one in is as a full partner.

AT&T (a member of the Intel consortium), for example, recently announced its Worldvox wide-area interoperable desktop video service. It was interesting that Intel was excluded.

Consortium models such as the ATM Forum catalyzed their market. The desktop video market needs such a catalyst. The

only way to jump-start it is through strong leadership derived by consortia of mutually consenting participants engaged in the definition of an enterprise video-network architecture. The Compaq and PictureTel alliance may be the genesis of a larger industrywide effort during 1995. By creating consortia, vendors can assure interoperability and spur videoconferencing to become the biggest communications revolution since fax.



*The market needs
leadership to define vision
and standards.*

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To Network or Not to Network

Others may wax eloquent on the Office of the Future; I break into a sweat when I hear about Microsoft At Work—Microsoft's architecture for adding Windows to copiers, printers, and other apps.

To understand why, let me take you on a journey into the past, a distant time when fax machines were downright rare. If a company even had one, it was usually on the 29th floor of a building three blocks away, and you had to make an appointment to use it. A couple of years later, there was one on your floor, and secretaries were asking you what they should buy.

That's when I started paying attention. I was a LAN manager after all. And just as those little boxes started sprouting all over, I began reading about fax gateways and getting calls from vendors who wanted to sell me one. The idea gave me goose bumps, the ones that tell me something's a perfect LAN application. Think of the opportunity, I told myself. A fax gateway was bound to be cheaper than a bunch of standalone fax machines, and users would be thrilled to send faxes from their desks. I'd be a hero, which is what every LAN manager secretly wants to be.

A tad of research disabused me of that bit of wishful thinking. Outbound faxing saved time only when the document to be faxed was already on the network, but most of my users faxed non-network documents. If they had to scan the document first, LAN-based faxing wasn't going to save any time. The inbound situation was, and remains, even worse. Direct-inbound-dialing solutions are expensive and hard to justify. Server-based routing raises serious security issues and is awkward and slow. OCR solutions that read fax cover pages require standardization from senders that is impossible to achieve in most environments.

But two other factors put the nail in the coffin of my interest in LAN-based faxing: cost allocation and responsibility. The small, standalone fax machines would be bought by departments, out of departmental budgets. The phone lines would be paid for by those same departments. Perhaps most important, if something went wrong with a fax, on either the inbound or outbound side, it would be the department's problem. On the other hand, once I set up a LAN-based faxing solution, the phone charges would become part of my budget (with no tools for automati-



By Diane
Danielle

cally reallocating charges to the responsible departments), and my staff and our LANs would be responsible for whatever went wrong.

For the first time in my LAN-management life, I turned down the opportunity to take on more responsibility, and neither I nor my users regretted the decision.

I tell this story to illustrate the gap that can exist between adding networking capabilities to office equipment and creating a business solution.

Think about copiers that can double as computer printers. At first glance, sticking an Ethernet connection in a copier seems even smarter than putting one in a fax machine. High-end copiers are fast. Even better, they're paid for out of somebody else's budget, a budget used to supporting copier-size expenses.

Consider, however, the practical process. What happens to print jobs sent from the LAN if somebody is making 50 copies of a 100-page document? Sure, the copies will stay in a queue and get printed later, but users will have to wait longer for the copy machine than they would for a laser printer.

If, on the other hand, the copier is busy printing out network documents, how does somebody get access to the copier function? Can any user just stop the print queue and start up the copier function? Who does the arbitration?

What about maintenance and reliability? Our HP LaserJets hardly ever broke down; our copiers (from a variety of different manufacturers) hardly ever seemed to be up. I've learned the hard way that if something attached to the LAN doesn't work, it's the LAN—not the something—that gets blamed. Why taint a solid network with the reputations earned by copiers?

Before we get all excited about building computers and networking into every piece of equipment in the office, whether it's the copier or the VCR, the printer or the PBX, we'd better ask ourselves if we're adding more function or just more cost and more hassle. Extending the network's domain means extending the network manager's responsibilities. It's not a load to be assumed lightly.



*If something attached to the LAN
doesn't work, the LAN—not the
something—gets blamed.*

DIANE DANIELLE is an independent networking consultant in Berkeley, California. She can be reached on CompuServe at 70020.645 or MCI Mail at 383-1159.



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Climb Aboard the NetWare 4.x Express

David, I sat through Novell's big Interop announcement and couldn't believe my ears. I couldn't believe that the same classy company that successfully blended cooperation and competition into one verb had coughed up an awful term like "Super NOS." Ugh! I think Novell's bad taste just tipped the networking balance in Microsoft's favor.

Novell's Robert Frankenberg told us (the press release labeled it as his "vision") that the planned Super NOS will blend the best of NetWare and UnixWare and that it will be deployed in three steps. About that time I flashed back to the "vision" and "migration strategy" briefings I used to get from Wang and Digital. A road map is dandy, but who wants to make the trip?

I don't see the gain for the users' pain. Frankenberg and the Novell execs talked about all of the Super NOS servers operating as one giant computer. They talked about one sign-on and one virtual source of files and services. That's okay, but often networking advocates get too far out ahead of the real users. In many large organizations, managers aren't too excited about giving everyone virtual access to everything. I admit that organizations have become flatter, but I think the flow of information is still to and from a central point within the organization. Also, even if distributed computing is a desirable goal, what's the cost? Distributed computing means a lot more overhead in the communications pipes, and it uses really complex software. If it's a trade-off between maintaining login scripts and incurring more communications and support costs, I'll take the login scripts.

If a journey starts with the first step and that step is NetWare 4.1, then I'll stay home. Novell's execs have vowed to make NetWare 4.x easier to set up, but few companies need its power or cost. If Novell's planners envision pushing for the high-end corporate niches, they should drive around Route 128 in Boston and see how well that strategy worked for Wang and Digital. Those companies left a lot of niches (and buildings) to fill.

While Novell is giving up on the desktop and focusing on Super NOS, Microsoft knows that if you control the desktop, you control everything. Microsoft has set the standards for program-to-program communications, and Windows NT 3.5 is not only familiar and easy to use, but is ready to match NetWare's features.



Frank Derfler:
Super NOS? You mean Super Dud! I'd sooner stick with NetWare 3.11 or Windows NT.

Oh my, look who's judging a book by its cover! Frank, the blend of UnixWare's fault tolerance and mature administrative features with NetWare's core file and print services makes a lot of sense and is a good goal to shoot for. Don't pick on the company for its choice of a product name. Are you going to tell me that the name Microsoft Windows 95 is a winner?

Names aside, get your head out of the ground, Frank. NetWare 3.x was a fine product for its time. But when we move to robust enterprise networks with lots of remote and mobile connections, NetWare 3.x just won't have the facilities we're going to need. Take single-user login, for example. You simply must be able to move anywhere in the organization and gain access to the network. Sure, with 3.x we have some rudimentary tools, but there's

nothing like the single-user login of NetWare 4.x. You still need to be able to find the server you need to login to in order to access the network, and even then you aren't guaranteed access to your applications.

The technology that underlies single-user login—Novell's Directory Services (NDS)—will also let users locate network resources such as printers and fax servers without having to know their associated server. This goes a long way toward making networking more effective and simpler to use.

There are other goodies that 4.x also provides, such as enhanced security. But perhaps the biggest point is a nontechnical issue: service and support. As we move forward, expect Novell to enhance its support for NetWare 4.x and gradually deemphasize 3.x. NetWare 4.x is clearly its development platform of the future. If you are going to want the best of Novell, I say expect to find it there, and on its Super NOS.

Admittedly, NetWare 4.01 had its share of bugs, which Novell will have to fix in 4.1. Novell will also need to make the NOS easier to install. But those users who do make the jump to 4.1 should be able to leverage new applications that will link NDS with good old MHS—the proven standard among messaging protocols. That's a compelling combination for developers of corporate applications.

By adding parallel management tools and management schemes, the transition to 4.x will be even easier. Sure, the transition won't happen overnight. But throw in the other goodies of 4.x, and you've got the right NOS for the future. □



David Greenfield:
NetWare 3.11 may be okay for some, but if you're serious, you'll move to 4.1.

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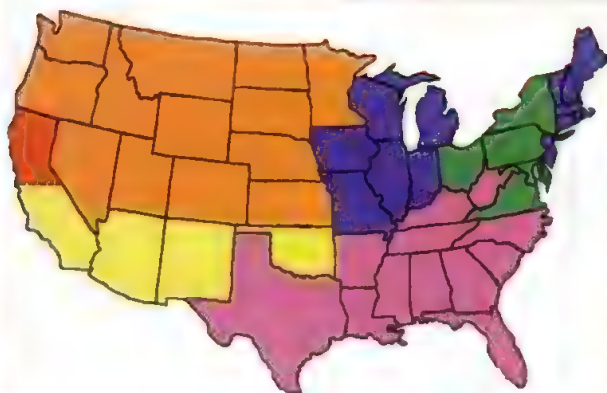
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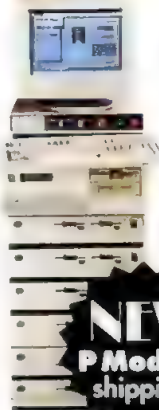
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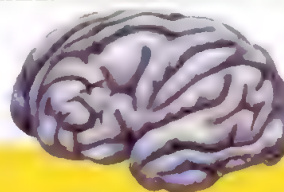
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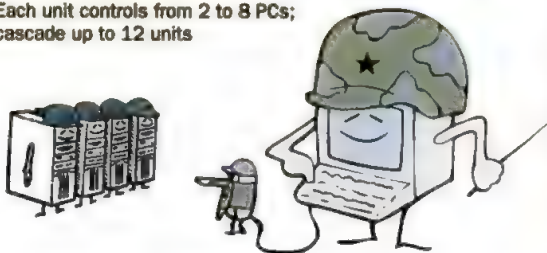
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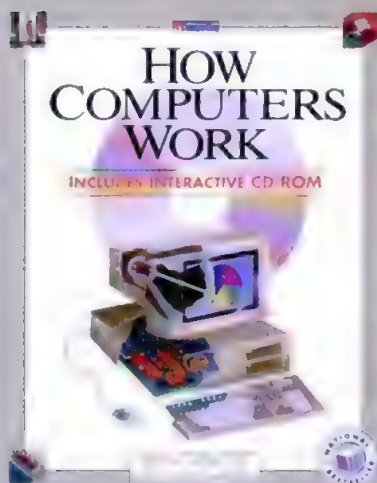
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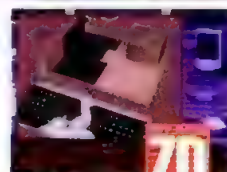
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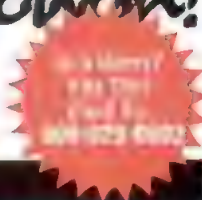
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User-to-User

BY NEIL J. RUBENKING

Prevent Accidental Overwrites

In the Solutions column of October 26, 1993, a reader complained about accidentally overwriting the original version of a file by selecting Save instead of Save As in a Windows application. Having done the same thing on occasion, I thought I'd suggest a bit of behavior modification that might help.

Whenever I load a file with the intention of keeping the original and saving modifications in a new version, I immediately do a Save As with the new name. Most Windows products I've used not only write a new copy of the file, but change the current document name so that later Saves write to the new file copy.

*Scott Gourley
Watertown, Massachusetts*

► **PC MAGAZINE:** I use this technique myself. If you're a DOS old-timer, you're especially liable to run into trouble with the standard Windows Save and Save As menu commands. DOS programs commonly ask for confirmation before overwriting a file, even if it's the same file you originally loaded into the program. In Windows programs, on the other hand, *Save* means save the current data back to the file from which it was loaded—without confirmation.

If you save to the new filename right away, there's no chance that you'll accidentally overwrite your original if you suddenly need to do a Save before switching to another project.

Passing Parameters in Batch Files

A simple batch file I wrote failed to pass a parameter correctly when a forward slash (/) rather than a space was used as the separator between the filename and the parameter. To find out what was going on, I wrote TEST.BAT as follows:

```
@ECHO OFF
ECHO Batch file %0; parameter %1
```

On execution, %0 should be replaced with the batch file's name, and %1 should return the first command-line parameter. Run this batch file with the command TEST/X/Y, though, and you get

```
Batch file TEST/X; parameter /Y
```

It seems that COMMAND.COM parses the command line differently for batch files than for other executables. For .EXE or .COM files, PROGRAM/X/Y is equivalent to PROGRAM /X /Y. This

anomaly could come as an unpleasant surprise to anyone accustomed to entering command-line switches right after the program name (as in CHKDSK/F). For instance, batch files often provide syntactical help with a line like

ECHO Syntax: %0 /parameter

since the use of %0 rather than the batch file's name allows the help message to remain correct even if the user renames the batch file. But if you omit the space between the filename and a parameter that begins with a slash when you call a batch file, the syntax message will erroneously include the parameter as part of the filename.

*Roberto Werneck
Rio de Janeiro, Brazil*

► **PC MAGAZINE:** The simplest solution to this problem is to write batch files using command-line switches that don't begin with a forward slash—but you can't always do that. If, for example, you're writing a batch file "wrapper" for the CHKDSK command, you'll want to accept the /F switch, just as CHKDSK does. FIXPARM.BAT (Figure 1) lets you separate command-line switches that are run together with the batch file's name.

Normally the space character separates the FOR command's list of items, but the forward slash can serve the same purpose. The third line in FIXPARM.BAT uses this fact to determine whether or not the batch file's name stored in parameter %0 contains a forward slash. If not, this line jumps to the label Continue. In this sample file, the lines after the label simply display the batch file's name and parameters.

Suppose the user types FIXPARM/X. In this case, the FOR command's (%0) becomes (FIXPARM/X), which—because of the forward slash—is processed as two items, FIXPARM and X. Neither of these is equal to FIXPARM/X, so the batch file does

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```
@ECHO OFF
SET Pargs=
FOR %v IN (%) DO IF '%v'=='%' GOTO Continue
ECHO IF NOT '%Pargs%'==' ' SET Pargs=%Pargs% /%1>TEMP$.BAT
ECHO IF '%Pargs%'==' ' SET Pargs=%1>>TEMP$.BAT
FOR %v IN (%) DO CALL TEMP$.BAT %v
DEL TEMP$.BAT
:Loop1
IF '%1'==' ' GOTO Out1
SET Pargs=%Pargs% %1
SHIFT
GOTO Loop1
:Out1
%Pargs%

:Continue
ECHO Batch file %0
ECHO Parameters
ECHO =====
:Loop2
IF '%1'==' ' GOTO Out2
ECHO %1
SHIFT
GOTO Loop2
:Out2
```



Figure 1: FIXPARM.BAT avoids problems caused by omitting a space between a batch file's name and command-line parameters that begin with a slash.

not jump to the label Continue. The next two lines create a temporary batch file, TEMP\$.BAT, which takes a single command-line parameter of its own. FIXPARM.BAT uses another FOR command to pass each portion of the %0 parameter to

the newly-created TEMP\$.BAT. If the Pargs environment variable is empty, the temporary batch file sets this variable equal to the first TEMP\$.BAT parameter. Otherwise, TEMP\$.BAT appends a space, a forward slash, and its first

parameter to the Pargs variable. Using the example command FIXPARM/X, the FOR command first passes FIXPARM, and TEMP\$.BAT sets the Pargs variable equal to FIXPARM. Then the FOR command passes X, and TEMP\$.BAT appends a space and /X to the Pargs variable. Now FIXPARM.BAT uses a loop containing the SHIFT command to append any remaining command-line parameters to the Pargs variable.

The %Pargs% line after :Out1 executes the contents of the Pargs variable. This has the effect of restarting FIXPARM.BAT, but with all command-line parameters separated by spaces. Try it! Enter commands like FIXPARM/X or FIXPARM/X/Y Zee.

There's one important limitation to this technique: Command-line switches that begin with a slash must be single letters. If you enter FIXPARM/ XRAY, FIXPARM will report two command line parameters, /X and /RAY!

You can download FIXPARM from PC MagNet's Utilities/Tips Forum as FIXPAR.BAT. □

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Tutor

BY JEFF PROSISE

The STACKS Command Revisited

In last August's Tutor column, I explained stacks and hardware interrupts and how they interrelate ("How Your System STACKS Up"). I also presented a small utility named STACKMON that helps you determine the optimum STACKS setting for your PC. The column prompted such a flood of e-mail that it seemed appropriate to pay this subject one more visit. Let's briefly review what we learned in that column.

Several times each second, your PC's CPU is diverted from the task it's currently executing by hardware interrupts emanating from other chips and devices. Hardware interrupts travel via IRQ lines to the interrupt controller, where they are sorted and prioritized and allowed to pass through one at a time. When a hardware interrupt arrives at its doorstep, the CPU temporarily halts what it's doing and executes the associated interrupt-handler code, which usually resides in the ROM BIOS or in adapter ROM. The interrupt handler, in turn, services the chip or device that generated the interrupt, after which the CPU resumes execution at the point where it left off. This interrupt-driven design allows a CPU to service its support chips and peripheral devices in an expedient manner. It also prevents the CPU from having to waste precious clock cycles by continually "polling" for input.

A crucial element in the processing of hardware interrupts is the stack—a region of memory where data can be temporarily deposited and quickly retrieved again, pointed to by the CPU's SS and SP regis-

ters. When a hardware interrupt occurs, the CPU saves the address of the code it's executing (along with other data) on the stack. In the course of processing the interrupt, the interrupt handler will probably copy additional data to the stack. The stack isn't located at any single place in memory; its location changes as programs are loaded and unloaded. Typically, it is located above the currently running program's code and data. Since the stack grows downward in memory as data is added, it must not grow beyond a predetermined size. If it does, it will overwrite other parts of the program and cause no end of trouble.

The problem presented by hardware interrupts is that most hardware interrupt handlers assume that the program currently being executed has enough stack space to accommodate its own needs and the interrupt handler's, too. That's usually a safe assumption. But if hardware interrupts become nested—that is, if a second interrupt occurs before the first is completely processed, and then a third, and a fourth, and so on—then the likelihood decreases that the program will have enough stack space for all of them. A typical hardware interrupt handler requires anywhere from 16 to 128 bytes of stack space to store register values and other data. Thus, stack space require-

ments can mount up quickly when interrupts become nested. And if the stack overruns, then the system is almost sure to go down.

To help guard against such occurrences and ensure that each interrupt handler has the stack space it needs, DOS versions since 3.2 intercept selected hardware interrupts and provide the handlers with stack space from an internal stack pool. The STACKS command controls the size of the stack pool. The command

`STACKS=12,256`

sets up 12 stacks of 256 bytes each. This virtually guarantees that your system won't suffer a hardware-related stack overrun as long as interrupts don't get nested more than 12 levels deep and no interrupt handler requires more than 256 bytes of stack space. The downside is that you lose the nearly 4K of conventional memory that is set aside for the stack pool.

A setting of `STACKS=0,0` allocates no memory to the stack pool and effectively

If you don't determine the optimal STACKS setting for your PC and specify it in your CONFIG.SYS file, you can lose memory without knowing it.

disables DOS's handling of hardware interrupts. Most PCs run fine with STACKS set to 0,0, but some require higher settings. It all depends on the hardware and software that you use. If you don't specify a STACKS setting in your CONFIG.SYS file, DOS defaults to 9,128 for 80286 and later CPUs. Thus, you

can lose memory without knowing it. The default `STACKS=9,128` consumes almost 2K of conventional memory—RAM that could otherwise go to your applications. The question, then, becomes: What is the optimal STACKS setting for your PC?

LESSONS LEARNED To help answer this question, I wrote STACKMON, a TSR that sits in the background and counts nested hardware interrupts. If STACKMON reports `MaxInt=2`, then it never saw hardware interrupt handlers nested more than two levels deep. A PC with a `MaxInt` value equal to 2 usually runs fine with `STACKS=0,0`, because most pro-


```

N STACKCHK.COM
E 0100 E9 B3 00 52 65 71 75 69
E 0108 72 65 73 20 44 4F 53 20
E 0110 35 2E 30 20 6F 72 20 68
E 0118 69 67 68 65 72 0D 0A 24
E 0120 55 6E 61 62 6C 65 20 74
E 0128 6F 20 6C 6F 63 61 74 65
E 0130 20 74 68 65 20 44 4F 53
E 0138 20 64 61 74 61 20 73 65
E 0140 67 6D 65 6E 74 0D 0A 24
E 0148 43 75 72 72 65 6E 74 20
E 0150 53 54 41 43 4B 53 20 73
E 0158 65 74 74 69 6E 67 3A 20
E 0160 24 4E 75 6D 62 65 72 20
E 0168 6F 66 20 73 74 61 63 6B
E 0170 73 20 74 68 61 74 20 68
E 0178 61 76 65 20 62 65 65 6E
E 0180 20 75 73 65 64 3A 20 24
E 0188 4D 61 78 69 6D 75 6D 20
E 0190 64 65 70 74 68 20 72 65
E 0198 61 63 68 65 64 20 69 6E
E 01A0 20 61 6E 79 20 73 74 61
E 01A8 63 6B 3A 20 24 00 00 00
E 01B0 00 00 00 00 00 00 B4 30
E 01B8 CD 21 3C 05 73 0C BA 03
E 01C0 01 B4 09 CD 21 B8 01 4C
E 01C8 CD 21 B4 52 CD 21 26 8B
E 01D0 47 FE 8E C0 26 81 3E 08
E 01D8 00 53 44 74 13 BA 20 01
E 01E0 26 80 3E 00 00 5A 74 D9
E 01E8 26 03 06 03 00 40 EB E2
E 01F0 40 8E C0 26 8A 1E 00 00
E 01F8 80 FB 53 74 12 80 FB 4D
E 0200 74 0D 80 FB 5A 74 08 26
E 0208 03 06 03 00 40 EB E2 8C
E 0210 00 40 8E C0 2E A1 01 00
E 0218 A3 AD 01 26 A1 06 00 A3
E 0220 AF 01 B4 09 BA 48 01 CD
E 0228 21 A1 AD 01 E8 E7 00 B4
E 0230 02 B2 2C CD 21 A1 AF 01
E 0238 E8 DB 00 B4 09 BA 45 01
E 0240 CD 21 83 3E AD 01 00 74
E 0248 6C 26 A1 08 00 26 03 06
E 0250 0C 00 A3 B1 01 26 A1 0A
E 0258 00 A3 B3 01 C4 3E B1 01
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E 0268 3D 03 75 05 C6 06 B5 01
E 0270 01 26 8B 45 02 26 0B 45
E 0278 04 74 01 43 83 C7 08 E2
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E 0288 8B C3 E8 89 00 B4 09 BA
E 0290 45 01 CD 21 B4 09 BA 88
E 0298 01 CD 21 80 3E B5 01 00
E 02A0 74 16 A1 AF 01 E8 6E 00
E 02A8 B4 02 B2 2B CD 21 B4 09
E 02B0 BA 45 01 CD 21 EB 3A 90
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E 02C0 0E AD 01 51 57 E8 2E 00
E 02C8 89 0C 5F 59 46 46 83 C7
E 02D0 08 E2 F0 33 DB 8B 0E AD
E 02D8 01 BE 30 03 AD 3B C3 76
E 02E0 02 8B D8 E2 F7 8B C3 E8
E 02E8 2C 00 B4 09 BA 45 01 CD
E 02F0 21 B8 00 4C CD 21 26 8B
E 02F8 45 02 26 0B 45 04 75 03
E 0300 33 C9 C3 26 8B 7D 06 47
E 0308 47 8B 0E AF 01 2B F9 32
E 0310 C0 FC F3 AE 41 C3 BB 0A
E 0318 00 33 C9 41 33 D2 F7 F3
E 0320 52 0B C0 75 F6 5A 80 C2
E 0328 30 B4 02 CD 21 E2 F6 C3
RCX
230
W
Q

```



Figure 1: This DEBUG script creates STACKCHK.COM, which reports statistics for DOS's handling of hardware interrupts.

grams have enough extra stack space to piggyback two interrupt handlers. Higher MaxInt values may call for nonzero STACKS settings.

I have always felt that the vast majority of PCs run fine with STACKS=0,0, and the feedback I got from you seems to bear this out. I received very few reports of MaxInt values higher than 2. When higher MaxInt values were reported, however, setting STACKS to a number slightly higher than MaxInt invariably solved the problem. Consider this message I received on CompuServe, which was typical of the notes I received:

I read your article on STACKS with great interest. I had set STACKS=0,0 after installing Windows. Lately I have been having real problems with my 66-MHz 486DX2. I could boot only at 25 MHz and couldn't copy files to double-density 3.5-inch floppy disks except at 25 MHz. I frequently experienced lockups for no apparent reason. I tried all kinds of things to overcome this problem but finally resigned myself to booting and writing to 720K disks at 25 MHz and frequently rebooting when lockups occurred for other reasons. Then I tried STACKMON. It initially showed me a MaxInt value of 15, so I set STACKS=16,128. Shortly after that, I got the first Stack Overflow message that I ever recall getting. Now I have STACKS set to 20,128. So far, no problems. And it's the most amazing thing: I can now boot at 66 MHz and copy files to 720K disks too! I guess stack overflows were the problem all along. Thanks for bringing this issue to light.

One of the most interesting insights to come out of your letters was proof positive that in a very small number of cases, DOS can actually make matters worse, not better. I received one report from a reader who suffered repeated stack overflows after replacing a 200MB hard disk with a newer 500MB model from the same manufacturer. His STACKS setting was 9,256, which had never given him problems before. Experimentation proved that specifying fewer than 62 DOS stacks (using STACKS=62,256) would crash his newly upgraded PC, but that STACKS=0,0 would work just fine! Apparently, the small amount of additional

overhead imposed on interrupt handlers by DOS's STACKS code was just enough to force hard disk interrupts to become nested. Either that or the interrupt handler's stack requirements were modest enough that the current program stack could handle 62 of them.

The lesson here is twofold: First, if you set STACKS to a nonzero value, thereby allowing DOS to intercept hardware interrupts, and the number of nested hardware interrupts exceeds the number of stacks you specified, your system will crash—no matter how meager the stack space needs of the individual interrupt handlers. If each handler required just 6 bytes of stack space—the very minimum that an interrupt handler can require—and 33 of them occurred in rapid enough succession to cause nesting, a STACKS setting of 32,512 would not help you. Paradoxically, STACKS=0,0 might work fine, because the program stack might be large enough to accommodate 33 interrupts at once. (A typical program stack is anywhere from 512 bytes to 4K.) Second, the best way to prevent nested interrupts is to process interrupts quickly, so that each interrupt handler has a chance to finish its work before another interrupt occurs. When you're cutting it close to begin with, DOS's STACKS code may make the difference between an interrupt handler that finishes just in time and one that doesn't make it.

STACKMON's most glaring deficiency is that it doesn't tell you anything about the stack size. Determining the proper stack size—the y in STACKS=x,y—is still a matter of trial and error. In terms of memory consumption, there's a big difference between STACKS=62,256 and STACKS=62,64; the latter would probably have been sufficient to handle the newly installed hard disk had STACKS=0,0 not done the trick.

By using a debugger to examine the area of memory where DOS stores its STACKS data, I was able to determine that hardware interrupts on my primary PC rarely, if ever, require more than 58 bytes of stack space. Clearly, a 256-byte stack size would be wasteful. Even 128 bytes would be overkill; a stack size closer to 64 bytes would be much more memory-efficient. You don't want to cut it too close, but remember that DOS can usual-

ly compensate when an interrupt handler needs extra stack space by allowing the stack to overflow into the next lower stack in the stack pool. The lower stack is then marked with a special value that prevents it from being used again, ensuring that the data placed there will not be overwritten by a subsequent interrupt handler.

So that you can determine both the optimum number of stacks and the optimum stack size for your PC, I've put together a new utility named STACKCHK. STACKCHK examines the internal data

mal workday. Before you power down, type STACKCHK at the command prompt. You'll receive a report similar to this one:

```
Current STACKS setting: 32,256
Number of stacks that have been
used: 2
Maximum depth reached in any stack:
44
```

This report provides three important items of information. First, it verifies that

setting is 0,0. If it detects a setting of 0,0, STACKCHK will report

```
Current STACKS setting: 0,0
```

and nothing more.

STACKCHK cannot accurately determine the maximum depth reached in any stack if a stack overflows into the stack below it. A plus sign following the number on the maximum depth line indicates that this has occurred:

```
Current STACKS setting: 32,256
Number of stacks that have been
used: 11
Maximum depth reached in any stack:
256+
```

```
xxxx:0000  00 00 00 00 00 00 00 C6 00-00 00 00 00 00 00 46 01
xxxx:0010  00 00 00 00 00 00 00 C6 01-00 00 00 00 00 00 46 02
xxxx:0020  00 00 00 00 00 00 00 C6 02-00 00 00 00 00 00 46 03
xxxx:0030  00 00 00 00 00 00 00 C6 03-00 00 9C 04 52 04 46 04
xxxx:0040  00 00 7E 0A 2F 01 C6 04-00 00 00 00 00 00 46 05
```

Figure 2: This hex dump reveals the contents of a typical STACKS control block array when DOS is started with a setting of STACKS=9,128. Nonzero values in the third through sixth bytes of an 8-byte control block indicate that the corresponding stack has been used at least once. Here, two of the nine stacks have been used; the rest have yet to be allocated to an interrupt handler.

structures that DOS uses to manage the stack pool and reports both the number of stacks that DOS has allocated from the pool (which should agree with the MaxInt value that STACKMON reports) and the maximum number of bytes actually used in any of the stacks. Together, these two values offer the most definitive information yet about the proper STACKS setting for your PC.

I received several e-mail messages from Internet users who could not download STACKMON because they lacked access to ZiffNet. Therefore, the DEBUG script for creating STACKCHK appears in Figure 1. (If you do have access to ZiffNet, you can save yourself some typing by downloading STACKCHK from the Utilities/Tips Forum, where it is archived as STACKC.ZIP.) To create STACKCHK.COM, enter the script exactly as shown in an ASCII text file named STACKCHK.SCR and type DEBUG <STACKCHK.SCR at the DOS prompt. I've departed from my normal practice of printing DEBUG as lists of assembly language instructions in order to make the listing as compact and easy to enter as possible.

Using STACKCHK is easy. First, endow your CONFIG.SYS file with a rather generous STACKS command—say, STACKS=32,256. Then reboot and use your PC through the course of a nor-

mal workday. Before you power down, type STACKCHK at the command prompt. You'll receive a report similar to this one:

```
Current STACKS setting: 32,256
Number of stacks that have been
used: 11
Maximum depth reached in any stack:
82
```

you'd probably need a STACKS setting of at least 11,100. STACKS=12,128 might be more advisable, if for no other reason than to provide DOS a little breathing room. Note that STACKCHK cannot work effectively if the current STACKS

If you see a report like this, you should increase the stack size and repeat the experiment. STACKS will accept stack sizes as large as 512 bytes.

There are four things you should be aware of as you use STACKCHK: First, it requires DOS 5.0 or higher. Second, you may run it from a DOS prompt inside Windows without fear of crashing the system. Third, it's not a TSR, so it doesn't consume a single byte of memory. Nor does it impose any overhead of its own on interrupt handling. Finally, it may not work if you've used QEMM or another memory manager to relocate DOS's STACKS data to upper memory. Move STACKS temporarily back to conventional memory and STACKCHK should work just fine.

INSIDE STACKCHK If you're curious to know how STACKCHK works, here's a brief explanation. To manage its stack pool, DOS uses an array of undocumented data structures, which I'll call *control blocks* to be consistent with the naming convention used in Andrew Schulman et al.'s priceless book *Undocumented DOS* (Addison-Wesley, 1993). Each control

```
xxxx:0440  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
xxxx:0450  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
xxxx:0460  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
xxxx:0470  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
xxxx:0480  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
xxxx:0490  00 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
xxxx:04A0  00 00 00 00 00 00 00 00 00-4C CA FF 01 74 33 02 38
xxxx:04B0  00 00 02 9C 26 A2 03 00-20 9C 77 9D 2F 01 52 04
xxxx:04C0  90 01 2B 04 46 30 40 00-00 00 00 00 00 00 00 00
```

Figure 3: This shows the contents of one of the stacks in DOS's stack pool. Only 32 of this stack's 128 bytes have been used, as evidenced by the unbroken string of zeros from offset 448h to 4A8h.

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PC TECH
Tutor

block is 8 bytes in length. There is one control block for each stack in the stack pool, and the control blocks are arranged contiguously in memory.

The hex dump in Figure 2 shows what the control block array looks like when DOS is started with a setting of STACKS=9,128. The first 8 bytes in the listing are the control block array for the first (lowest) stack in the stack pool; the second 8 bytes correspond to the second stack, and so on. The first byte in each control block is a status value for the corresponding stack. The value 00h means the stack is free, 01h means it is currently in use, and 03h means it has been corrupted by the overflow of a higher stack. The second byte is unused.

The next 4 bytes are the ones that interest us. When DOS allocates a stack to an interrupt handler, it stores the interrupt handler's original SS and SP values here. If these bytes are 0, then the stack has yet to be used. If they are nonzero, then DOS has allocated the stack to an interrupt handler at least once. To determine how many stacks have been allocated from the stack pool, STACKCHK simply counts the number of control blocks with nonzero values in the third through sixth bytes. In the example in Figure 2, two of the nine stacks have been used; the rest have yet to be allocated to an interrupt handler. Observe that DOS allocates stacks from the highest address to the lowest address. The ninth stack is the first to be allocated, the eighth is the second to be allocated, and so on. That's so that a stack that grows too far downward in memory will overwrite unused stack space rather than important data placed there by a previous interrupt handler.

Determining the maximum number of bytes used in any of the stacks is a bit trickier, but possible nonetheless. The final 2 bytes in each control block specify the memory address of the corresponding stack, expressed as a 16-bit offset relative to the base of the same segment that holds the control blocks. Thus, once we've located the control blocks, we can also lo-

cate the stacks themselves. Initially, all of the bytes in the stacks are initialized to 0. By counting upward from the bottom of a stack until we reach a nonzero value and subtracting the count from the stack size, we can make a reasonable guess at the maximum number of bytes used. (Why a "reasonable guess"? Because it's always possible—though unlikely—that the interrupt handler pushed a bunch of zeros onto the stack at the very end.) STACKCHK checks all the stacks that have been used at one time or another and reports the largest value that it finds.

Determining the maximum number of bytes used in any of the stacks is a bit tricky, but possible nonetheless.

Figure 3 shows a hex dump of a 128-byte stack in which exactly 32 bytes have been used. Note the unbroken string of zeros in the stack's first 96 bytes, a nearly certain indicator that this portion of the stack has yet to be used. Also note that the top word in the stack is set to 0400h, which happens to be the memory offset of the stack's control block. I said in the August issue that the topmost word in each stack is a "magic number" that lets DOS determine when a stack has been corrupted by overflow from a higher stack. The magic value is actually the offset address of the stack's control block. When DOS searches the stack pool and finds a free stack whose top word does not contain the address of the control block, it concludes that the stack has been overwritten and copies the value 03h to the control block's status byte. That stack remains off limits for the remainder of the session to prevent the stack above it from possibly becoming corrupted as well.

ASK THE TUTOR It's fun to dig around in the system to learn how certain aspects of DOS work, especially when we can put that knowledge to use. In the future, we'll examine other DOS internals to acquire insights into little-used and insufficiently documented commands, such as FCBS. If there are other aspects of DOS or Windows that you'd like to know more about, drop me a note in the Tutor section (Section 3) of ZiffNet's Utilities/Tips Forum. My CompuServe ID is 72241,44. □

Power Programming

BY GUY SCHARF

Programming OS/2 Containers

What is an OS/2 container control? A container is a window that displays items, or objects in a format selected by the user or the programmer. OS/2 uses containers extensively, and the container gives OS/2's Workplace Shell much of its flavor. All of the folders on the OS/2 desktop are containers. The Workplace Shell desktop is itself a container seen in icon view.

As I'll demonstrate in this article, OS/2 container controls also provide a way for you to present information in a table format, scroll through the table, adjust the columns you're viewing, and alter the table's data.

You can download the code mentioned here from PC MagNet's Programming Forum archived as CONTAI.ZIP.

CONTAINER BASICS If you open the Drives folder, select a drive, and open it, you will see a container showing directories on the drive, arranged hierarchically. This representation is called a Tree view. Select Open from the system menu again, press the right arrow button, and you can open Settings and select Icon view, Tree view, or Details view. The three views are all different ways a container can display the directories and files on a drive.

The container control supports five views of its contents: Icon, Name, Text, Tree, and Details. Icon views are bitmaps with strings beneath them. The Workplace Shell desktop defaults to the Icon view unless you change the settings for that folder. Name views are bitmaps with text to the right. Text views are strings without any pictorial representation. Tree

views are bitmaps with text to the right and are a way to display a hierarchy (often indicated by plus and minus signs).

Details views can be bitmaps, text strings, numbers, times, dates, or any combination of all these arranged in a table. If you open the Drives object and open a directory folder in Details view, you will see a table of filenames, sizes, dates, and related information. You can scroll the view horizontally and vertically. A split bar allows you to alter the space used for icon, title, and information about the file.

Container windows support direct manipulation; you can select items with the mouse and drag and drop them onto other containers, applications, or windows. For example, using the right mouse button, you can drag a file from one folder to another folder or to a printer.

A container may change the way its contents are displayed by changing the view. In the Workplace Shell, different views are typically seen by opening windows with an alternative view. It is also possible to change the view within a single window. Only one view can be displayed in a container window at a time.

THE DETAILS VIEW As you might imagine, a control that performs all of these functions is more complex than an entry field or list box, and the documentation can be daunting. The documentation for the container control is larger than that for any of the other controls in-

troduced with OS/2 2.0.

Programmers frequently need multi-column list boxes for applications. While you can use the owner-drawn feature of the list box control to implement this, the Details view of the container is easier and more powerful. The container supports horizontal and vertical scrolling, container and column titles, drag-and-drop, direct editing of data in the container, and more.

Figure 1 shows a container with a Details view. It demonstrates the many container features not easily implemented in a list box. The two-line, centered, non-scrolling heading is part of the container itself; it is not static text outside the container. A horizontal line is automatically placed beneath the heading.

The columns have headings, too. Some of the headings are left justified, some are right justified. These headings also have a horizontal separator line beneath them. The container's vertical scroll bar does not extend to the headings, indicating that the headings stay fixed as you scroll the rows of the container vertically.

OS/2 container controls provide a way to present information in a table format, scroll through the table, adjust columns, and alter the table's data.

The container's *split bar* is indicated by a vertical double line between the first and second columns. Grab the line with the mouse and you can drag it left or right to adjust the relative sizes of the window's two pieces. Each portion of the window can be scrolled horizontally, and the column headings scroll, too.

The data in the columns is formatted. Text strings are left justified; numeric values and dates have correct punctuation as specified by the system settings and are right justified.

These features are sophisticated but are easy to implement with a container. The basic steps for programming a container are the same as for other OS/2 controls. You must create the container, load it with data, and shut it down when you are done. You might also need to monitor or modify the container's operation and retrieve data from it. Because the container is more complex than other OS/2

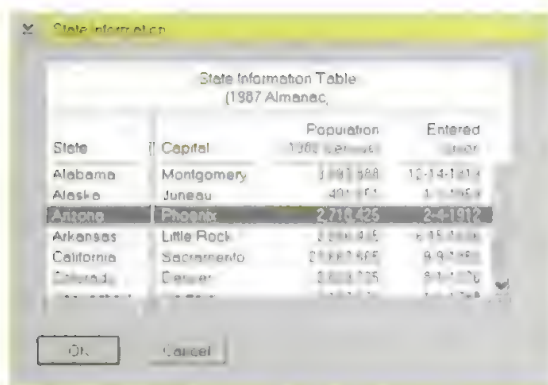


Figure 1: The information in this dialog box is displayed using a container Details view. The split bar makes it easy to navigate around the table.

controls, however, it requires more complex setup than other controls.

CREATING A CONTAINER As with other controls, a container can be created by placing a CONTROL statement in a resource script or by calling WinCreateWindow. WC_CONTAINER is the window class name.

In the application shown in Figure 1, the container is used as a control for a dialog box. In the Workplace Shell drive folders, the containers occupy the entire window. That difference is a design choice. For the sample program, the appearance of a list box in a dialog was desired.

The container control supports a small set of style flags. The flags that apply to the Details view are CCS_READONLY, CCS_SINGLESEL, and CCS_MINIRECORDCORE. CCS_READONLY makes the entire container read-only. If you don't make the container read-only, the user can modify the container title and container records. If you want to allow the user to modify some data but not all, you would omit this style and later mark the appropriate container titles, records, column titles, or column contents as read-only.

CCS_SINGLESEL specifies that only one container item can be selected at a time. CCS_MULTIPLESEL allows the user to select zero or more items. Both of these are similar to list-box styles and provide similar functions. The container control also has the CCS_EXTENDSEL style, which allows the user to select one or more container items. CCS_MINIRECORDCORE specifies that a smaller record structure be used for this container.

er. Records are a key concept of containers. Notice that the type of view was not specified as a style, and other information is not yet known either. You must initialize the container programmatically using CM_SET-CNRINFO and other messages.

THE RESOURCE SCRIPT Figure 2 shows the resource script used to create the dialog and container. The CONTROL statement creates a control of the WC_CONTAINER class with CCS_SINGLESEL, CCS_READONLY, and CCS_MINIRECORDCORE styles.

The PRESPARAMS statement sets the font within the container to 8-point Helvetica. A \0 is included at the end of the font-name string so that it works properly with OS/2 2.0.

The container control itself has no margin surrounding it. The lack of a margin is convenient when the entire client area of a window is to be occupied by a

The data for each item in the container is stored in a record. The container control manages the records. The programmer asks the control to allocate memory for the records, fills in the fields of the records, and tells the container to insert the records into the container. When the container window is closed, the container frees the memory for the records automatically.

All records of a specific container must have the same structure. There are two issues to consider in determining the record format. The first is whether the large record format (RECORDCORE) or the small record format (MINIRECORDCORE) should be used for basic container control information. The second issue is how much additional space for programmer-maintained data should be included in each record.

The basic record structure (RECORDCORE or MINIRECORDCORE) has control information that the container uses to maintain the records. The MINIRECORDCORE structure con-

```
DLGTEMPLATE IDLG_EXAMPLE LOADONCALL MOVEABLE DISCARDABLE
BEGIN
  DIALOG "State Information", IDLG_EXAMPLE, 40, 27, 310, 150,
    WS_VISIBLE, FCF_SYSMENU | FCF_TITLEBAR
  BEGIN
    CONTROL "", IDCN_STATEINFO,
      20, 31, 270, 110, WC_CONTAINER,
      CCS_SINGLESEL | CCS_READONLY |
      CCS_MINIRECORDCORE |
      WS_GROUP | WS_TABSTOP | WS_VISIBLE,
      PRESPARAMS PP_FONTNAME, "8.Helv\0"
    GROUPBOX "", 300, 19, 30, 272, 116
    DEFPUSHBUTTON "OK", DID_OK, 15, 9, 48, 13, WS_GROUP
    PUSHBUTTON "Cancel", DID_CANCEL, 78, 9, 48, 13,
      NOT WS_TABSTOP
  END
END
```



Figure 2: This resource script to create the dialog box specifies the styles to be used, sets the font to 8-point Helvetica, and creates a margin around the container.

container. The GROUPBOX statement was used to place a margin around the container for appearance's sake. The GROUPBOX statement must follow the CONTROL statement for the container itself.

CONTAINER ITEMS AND RECORDS A container item is anything the user or programmer might store in a container. The container is a general-purpose object and can hold many different types of items. Car, truck, bicycle, and unicycle objects could all be stored in the same container.

tains only the minimum information necessary for a container item: a pointer to a text string, a handle to an icon, a chain pointer to the next record, the position of the icon in an icon view, and some attribute flags.

The larger RECORDCORE structure contains the above information and then some. RECORDCORE supports different text strings for Text, Name, and Tree views, so each record can be displayed differently according to the view. RECORDCORE is the default data structure.

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```

CNRINFO    cnrinfo;                // Cntr info structure

memset (&cnrinfo, 0, sizeof(CNRINFO));
cnrinfo.cb = sizeof (CNRINFO);

cnrinfo.flWindowAttr = CV_DETAIL      |
                      CA_DETAILSVIEWTITLES |
                      CA_CONTAINERTITLE  |
                      CA_TITLESEPARATOR;

cnrinfo.pszCnrTitle = "State Information Table\012"
                      "(1987 Almanac)";

WinSendMsg (hwndContainer, CM_SETCNRINFO,
            MPFROMP (&cnrinfo),
            MPFROMLONG (CMA_FLWINDOWATTR | CMA_CNRTITLE));

```



Figure 3: This code, executed during WM_INITDLG processing, initializes the container by putting values into the CNRINFO structure.

If you wish to use MINIRECORDCORE, you must specify the CCS_MINIRECORDCORE style when creating the container.

The RECORDCORE structure is most useful when a container will be displayed in several different views, because it allows you to specify different data for different views. MINIRECORDCORE is sufficient for a container that has only a list or Details view.

The information in these data structures is sufficient to control the basic operation of a container but is usually insufficient for an application. The container control allows you to append any information you wish to the basic record structure. When you want the container to allocate memory, you must tell it how many extra bytes you want allocated in each record. The usual way to program this is to declare a C struct. The first element of the struct must be RECORDCORE or MINIRECORDCORE. You can then add as many data fields as you find useful.

One common use of these additional bytes is to store strings. The only required data element in the record is a pointer to the string. The strings themselves can be located anywhere in memory. If the strings are in memory that the programmer has allocated, then that memory must remain allocated for the life of the record. It may be more convenient to copy the strings into the container records and let the container manage the memory.

In this program, only the Details view is used, so the MINIRECORDCORE structure provides all of the needed control information. The first element of the RECORD structure is the required

MINIRECORDCORE followed by application data:

```

typedef struct
{
    MINIRECORDCORE RecordCore;
    PSZ    pszCapital;
    ULONG  ulPopulation;
    CDATE  cdateAdmitted;
    CHAR   szCapital[40];
    CHAR   szState[40];
} RECORD, *PRECORD;

```

The container allocates and frees these structures when requested by the programmer.

PROGRAMMING THE CONTAINER The dialog procedure for this program is extremely simple. In WM_INITDLG processing, the columns of the Details view are defined and the state data are loaded into the container. In WM_COMMAND, the dialog is dismissed when a button is pushed. That's it.

If I had allocated memory for use with this container, I would have freed that memory during WM_DESTROY pro-

pTitleData	field	flData
"State"	RecordCore.pszlcon	CFA_STRING
"Capital"	pszCapital	CFA_STRING
"Population\012(1980 Census)"	ulPopulation	CFA_ULONG
"Entered\012Union"	cDateAdmitted	CFA_DATE

Figure 4: The offset of each column (offStruct) is calculated as off-
setof(RECORD, field).

cessing. Since the state data is for display only, I did not need to read any information from the control at dialog-box termination. If the user had been allowed to update the data or drag items in the

container to other objects, I would have had to handle WM_CONTROL notifications from the control.

Figure 3 shows code executed during WM_INITDLG processing to complete initialization of the container. Here is the first use of the CNRINFO structure. This structure and the related CM_SETCNRINFO message are used extensively for programming containers.

Since the CNRINFO structure is on the stack, I first clear it and then set the structure size in cnrinfo.cb. I set the container attributes field in cnrinfo.flWindowAttr to request the desired appearance: CV_DETAIL (Details view), CA_DETAILSVIEWTITLES (column titles), CA_CONTAINERTITLE (title area for the container itself), and CA_TITLESEPARATOR (horizontal line under the container title). The pointer to the container title goes in cnrinfo.pszCnrTitle. The new-line character (\012) in the title causes the title to appear as two lines.

The CNRINFO structure contains many fields. When you send the CM_SETCNRINFO message to the container, you must tell it what parts of the CNRINFO structure should be examined by using CMA_* flags ORed together in the mp2 field. In this case, I set CMA_FLWINDOWATTR (set window attributes) and CMA_CNRTITLE (set the title text). Those are the only two fields in CNRINFO that were filled in. If I had completed other fields, I would have needed to specify other CMA_* values to ask the container to process those fields.

DEFINING THE COLUMNS Now that the container characteristics have been set, it is time to define the columns. The container manages the control structures for the columns. You use the CM_ALLOCDETAILFIELDINFO message to ask the container to allocate those structures for the number of columns needed. This message returns a pointer to the first FIELDINFO structure in a chain of structures. The

container has initialized the structures to 0 and set the structure length (cb) and chain (pNextFieldInfo) fields. After obtaining the FIELDINFO structures, you complete the data in each structure to


```

USHORT    cColumns = 4;           // # of columns
PFIELDINFO pFieldInfoHead;        // --> First field
PFIELDINFO pFieldInfo;            // --> Current field
FIELDINFOINSERT FieldInsertInfo;

pFieldInfoHead = (PFIELDINFO) PVOIDFROMMR (
    WinSendMsg (hwndContainer,
        CM_ALLOCDETAILFIELDINFO,
        MPFROMSHORT (cColumns),
        0));

pFieldInfo = pFieldInfoHead;      // Start at top of list

//-----
// Load the field info structures for all columns
//-----

for (i = 0; i < cColumns; i++)
{
    pFieldInfo->cb                = sizeof (FIELDINFO);
    pFieldInfo->flData             = // Field attributes
    pFieldInfo->flTitle            = // Title attributes
    pFieldInfo->pTitleData         = // Column title
    pFieldInfo->offStruct          = // Offset of data
    pFieldInfo->pUserData          = NULL;
    pFieldInfo->cxWidth            = 0;

    if this is the last column to the left of the split bar
    {
        SWP    swp;
        WinQueryWindowPos (hwndContainer, &swp);
        cnrinfo.pFieldInfoLast = pFieldInfo;
    }

    cnrinfo.xVertSplitbar = // split at 33%
        (swp.cx * 33) / 100;
    WinSendMsg (hwndContainer, CM_SETCNRINFO,
        MPFROMP (&cnrinfo),
        MPFROMLONG (CMA_PFIELDINFOLAST |
            CMA_XVERTSPLITBAR));
    pFieldInfo = pFieldInfo->pNextFieldInfo;
};

//-----
// Construct the FIELDINFOINSERT structure that describes
// the number of fields to be inserted, where they are to
// be inserted, etc.
//-----

memset (&FieldInsertInfo, 0, sizeof (FIELDINFOINSERT));
FieldInsertInfo.cb                = sizeof (FIELDINFOINSERT);
FieldInsertInfo.pFieldInfoOrder  = (PFIELDINFO) CMA_END;
FieldInsertInfo.cFieldInfoInsert = cColumns;
FieldInsertInfo.fInvalidateFieldInfo = TRUE;

//-----
// Insert the fields
//-----

WinSendMsg (hwndContainer, CM_INSERTDETAILFIELDINFO,
    MPFROMP (pFieldInfoHead),
    MPFROMP (&FieldInsertInfo));

```



Figure 5: The pseudo-code shown here demonstrates how you define the columns.

control the characteristics of each column.

You must set `flData` to describe the appearance of the column by ORing together attribute flags. The data to be displayed can be one of five types:

- `CFA_ULONGdata` is a `ULONG`.
- `CFA_DATEData` is a `CDATE` structure.
- `CFA_TIMedata` is a `CTIME` structure.
- `CFA_BITMAPORICON` data is an `HPOINTER`.
- `CFA_STRINGdata` is a `PSZ`, not a `CHAR` array as the name might suggest.

You can use other flags to specify the justification of the data (`CFA_LEFT`, `CFA_RIGHT`, and `CFA_CENTER`), vertical positioning of data in the row (`DT_VCENTER`, `DT_TOP`, and `DT_BOTTOM`), and visual attributes (`CFA_HORIZSEPARATOR` for a separator below column headings, `CFA_SEPARATOR` for a vertical separator to the right of a column, `CFA_INVISIBLE` for an invisible column, `CFA_FIREADONLY` for a read-only field, and `CFA_OWNERDRAW` for a cell you will paint yourself).

The variable `flTitle` specifies the attributes of the column headings. Although the default column-heading data type is a string, you can specify `CFA_BITMAPORICON` for a graphical heading. The horizontal and vertical justification styles used for data can be used for the column heading. A column heading can also be made read-only with

`CFA_FIREADONLY`. For containers that allow user editing, you might want to make the titles read-only so that the user cannot modify the titles. The variable `pTitleData` points to the column heading string or the bitmap or icon.

The variable `offStruct` specifies the location of the data in the record. All data displayed in a column must be located in the data record. Note, however, that the `offStruct` value for a column of `CFA_STRING` is the offset of a pointer to a null-terminated string (`PSZ`), not the offset to the beginning of an array of characters. Setting `offStruct` to the offset of an array of characters instead of to a `PSZ` will cause an error when records are inserted into the container. This is probably the most common and confusing programming error made with the Details view.

Since `offStruct` for a `CFA_STRING` column points to a `PSZ`, the string itself can reside anywhere in memory and does not have to be located in the record. Placing the string within the record, however, may simplify memory management for some applications.

For other data types, the data is contained within the record. `CDATE` and `CTIME` structures are sets of three `ULONG` values. The container formats dates and times according to the current system-preference settings. `pUserData` is available for your use as a pointer to instantiate data or other application infor-

mation. `cxWidth` specifies the width of a column in pixels. If 0, the container will set the column width to the width of the widest element in the column. I usually leave this field at 0 to size the columns to reflect the data.

After you complete the `FIELDINFO` structure for each column, you must construct a `FIELDINFOINSERT` structure, tell it how many structures are to be inserted, and insert the fields by sending `CM_INSERTDETAILFIELDINFO` to the container.

Figure 4 shows the column title, variable name, and data type for each column of the sample program. The offset is calculated as `offsetof (RECORD, field)`. The `flData` variable also specifies `CFA_HORIZSEPARATOR` for all columns. The `flData` and `flTitle` variables both have `CFA_LEFT` for string fields and `CFA_RIGHT` for other fields.

Figure 5 shows the pseudo-code for defining the columns. First you load the field-information structure for all columns. Then you create a structure that describes the number of fields to be inserted and where they are to be inserted. Finally, you actually insert the fields.

SETTING THE SPLIT BAR Setting the split bar requires modifications to the container setup information. The split bar is not part of the `FIELDINFO` information as such. You need to obtain a pointer to the `FIELDINFO` structure for the last


```

PRECORD    precord;          // -> container records
PRECORD    precordFirst;     // -> first container record

RECORDINSERT recordInsert;   // Record insertion control

//-----
// Allocate memory for all user records
//-----

cbExtraBytes = (ULONG)(sizeof(RECORD) -
                        sizeof(MINIRECORDCORE));
precord = (PRECORD) WinSendDlgItemMsg (hwndDlg, idContainer,
                                        CM_ALLOCORECORD,
                                        MPFROMLONG (cbExtraBytes),
                                        MPFROMSHORT (cStates));

precordFirst = precord;

//-----
// Initialize all records
//-----

for (i = 0; i < cStates; i++, pastate++)
{
    //-----
    // Initialize the container record control structure
    //-----
    precord->RecordCore.cb = sizeof (MINIRECORDCORE);

    //-----
    // Copy data to container record from our tables
    //-----
    strcpy (precord->szState, szStateName[i]);
    precord->RecordCore.pszIcon = precord->szState;

    strcpy (precord->szCapital, szStateCap[i]);
    precord->pszCapital = precord->szCapital;

    precord->ulPopulation = // Population
    precord->cdateAdmitted.month = // Month Admitted
    precord->cdateAdmitted.day = // Day Admitted
    precord->cdateAdmitted.year = // Year Admitted

    // Move to next record
    precord = (PRECORD) precord->RecordCore.precNextRecord;
}

//-----
// Construct record insertion control structure
//-----

memset (&recordInsert, 0, sizeof (RECORDINSERT));
recordInsert.cb = sizeof (RECORDINSERT);
recordInsert.pRecordParent = NULL;
recordInsert.pRecordOrder = (PRECORDCORE) ((ULONG)
                                             MPFROMSHORT (CMA_END));

recordInsert.xOrder = (USHORT) CMA_TOP;
recordInsert.cRecordsInsert = cStates;
recordInsert.fInvalidateRecord = TRUE;

//-----
// Insert the records
//-----

WinSendDlgItemMsg (hwndDlg, idContainer,
                  CM_INSERTRECORD,
                  MPFROMP (precordFirst),
                  MPFROMP (&recordInsert));

```



Figure 6: Once the columns are defined, you can fill in the records. Here, I used fields defined elsewhere in the program to do this.

field to the left of the split bar and specify the position of the split bar. Set the values in the CNRINFO structure and then send a CM_SETCNRINFO message to the container, specifying the fields to be processed (CMA_XVERTSPLITBAR for the location and CMA_PFIELDINFOLAST for the last column to the left of the split bar).

To determine the position of the split bar, I get the dimensions of the container window in pixels and calculate the desired x-position of the split bar by taking a percentage of the window width. The best initial position for the split bar depends on the application.

ALLOCATING RECORDS You are now ready to load the records into the container. Since the container will manage memory for records, you must first ask the container to create the records using the CM_ALLOCORECORD message. Set the mpl parameter in that message to the number of extra bytes desired. Compute the number of extra bytes as the difference between your RECORD size and sizeof MINIRECORDCORE (or sizeof RECORDCORE if you are using the larger structure). The container allocates the requested records, initializing them to 0 except for the size (cb) and chain (precNextRecord) fields.

You can ask the container to allocate 1 or more records in a CM_ALLOCORECORD request. Allocating a block of 50

records will be faster than allocating 50 blocks of 1 record each, so it is best to add several records at the same time.

The CM_ALLOCORECORD message returns a pointer to the first record allocated. Now it is just a matter of filling in the records. Besides setting values in your extra bytes, you may also need to set values in the RecordCore structure. For an application using several container views and the RECORDCORE structure, you would usually need to initialize some fields in RECORDCORE.

Figure 6 shows how I did this; your approach may differ. Since I borrowed the RecordCore.pszIcon field to use as a pointer to the state name, I needed to set that pointer. Since my RECORD structure has CHAR arrays for the state and capital names as well as for the required pointers, I copy the text strings into each record and set the pointer to that string. The PSZ values must be in the record, because the CFA_STRING specifies the offset of a PSZ not of the beginning of a string.

Finally, create a RECORDINSERT structure, give it the number of records, tell it to insert these records at the beginning, and send a CM_INSERTRECORD message to insert the records.

The container is now up and running. Since this is a read-only container, there's nothing else that needs to be done. You can remove or insert additional records in the container at any time and at any place

in the list. You can also remove or insert columns at any time.

SHUTTING DOWN When the container terminates, it will free the memory it allocated for you. If you used malloc() to obtain any additional space while filling in the records, however, the container cannot release that space, since it does not know about that memory. Instead, you will need to examine the records, perhaps while processing the WM_DESTROY message to the dialog, and free any additional space you allocated.

In this example, freeing the column data and records is not required, because the container will free that memory. If you had been doing something else, however, such as switching from a Details view to a Tree view, you might have wanted to free the column data before the container had terminated.

There you have it: Container Details view with titles, column headings, vertical splits, and formatting. It's much nicer looking and more flexible than a multicolumn list box. Plus, the container has additional capabilities: direct manipulation (drag-and-drop), direct editing of column data, and more. □

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Utilities

BY DOUGLAS BOLING

Back to the Future With PCMKEY

Graphical user interfaces (GUIs) are all the rage. Microsoft Windows, the OS/2 Workplace Shell, and the Macintosh interface all provide easy-to-use point-and-click interfaces for the computer-phobic. But some things never die—even if we want them to. This is the case with the lowly command line interface.

Though the Macintosh has never had a command line interface, PC-compatible users have never really discarded the old DOS (or OS/2) prompt. The latest versions of DOS and OS/2 have crude command line editors, but (as with many of the standard features of an operating system) these command line editors could stand some improvement. So in this retro edition of the Utilities column, I present PCMKEY—an update to a series of command line editors that have been printed in *PC Magazine*.

PCMKEY is actually the third release of this command line editor. *PC Magazine*'s Tutor guru Jeff Prosis published the original version, called DOSKEY, back in 1987. This was long before Microsoft usurped the DOSKEY name for its command line editor in DOS 5.0. Jeff and I teamed up in 1989 to produce ALIAS. ALIAS used Jeff's original command line editor code from DOSKEY, but added the ability to load aliases for commands (known as *macros* in DOS's version of DOSKEY). ALIAS also allowed users to assign commands to function keys.

PCMKEY updates the basic design of ALIAS and contains numerous new features. With PCMKEY, you can assign editing functions to any key on the key-

board. PCMKEY implements features of DOS's DOSKEY, such as listing the command history and packing multiple commands on one line. PCMKEY also contains updates for running under Windows, something the original ALIAS had trouble with. And to top it off, PCMKEY uses less memory than the original ALIAS.

PCMKEY also offers some features that DOSKEY lacks. It allows environment variables in aliases, provides intelligent command stacking, and supports reassignable keys—all features missing from DOSKEY. PCMKEY also uses the Up Arrow key to search the command stack for a command instead of using the nonintuitive F8 key used by DOSKEY.

Bringing your command line into the nineties requires only a quick trip to *PC Magazine*'s PC MagNet. Refer to the sidebar "Guide to Our Utilities & How to Get Them" for details. PCMKEY is writ-

ten in assembly language and can be reassembled with most PC assemblers from Borland or Microsoft. To assemble under Microsoft's MASM, use the following commands:

```
MASM PCMKEY;  
LINK PCMKEY;  
EXE2BIN PCMKEY PCMKEY.COM
```

USING PCMKEY The only aspect of PCMKEY longer than its history is its list of command line switches. PCMKEY isn't hard to use, but it is designed to be as configurable as possible. Before explaining all 12 of PCMKEY's command line switches, I'll discuss the basics.

To install PCMKEY with default settings, simply type PCMKEY at the command line. PCMKEY is a small TSR (terminate and stay resident) program, taking up about 4K of conventional memory when first installed with the default settings.

At this point, no command aliases have been defined, but the command line editor is fully functional. To demonstrate this, type in a command such as DIR and press the Enter key. Your PC should then list the contents of the current directory. Now press the Up Arrow key. You should see the command DIR reappear on the command line. You can now edit the DIR command using the Backspace or Left Arrow key or type in an additional qualifier after the DIR. The default assignments for the PCMKEY command line editor are shown in Figure 1.

One enhancement of PCMKEY over DOSKEY is intelligent command stacking. When performing repetitive operations, I have always been annoyed that my command stack is filled up with one or two commands over and over. PCMKEY avoids this by checking to see if a command is already in the stack before storing it. If the command does exist, the duplicate command is deleted before the command is stored in the first position in the stack.

Another improvement over DOSKEY is how you search for buffered commands. In DOSKEY, if you want to search for buffered commands that start with the first few letters you've typed, you have to remember to press F8—and there's no way to search forward for matching com-

Top 10 Utilities

Rank	Utility
1	WTIME - Keeps PC clock accurate
2	FINDIR - Locates available IRQs
3	INCTRL - Controls Windows' installation
4	MONITOR - Monitors system resources
5	BAT2EX - Compiles batch files
6	THINDI - Streamlines hard disk
7	SWITC - Creates multiple Windows setups
8	BUGS - Windows 3.1 screen saver
9	PRUNE - Manages DOS files
10	MBOOT - Multiple boot program

This list is based on the total number of downloads each utility has had on PC MagNet over the past month. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."

Key	Function
Left Arrow	Moves the cursor one character to the left.
Right Arrow	Moves the cursor one character to the right.
Up Arrow	Recalls the previous command using any partial command as a search template.
Down Arrow	Recalls the next command in the stack using any partial command as a search template.
Home	Moves the cursor to the start of the command line.
End	Moves the cursor to the end of the command line.
Ins	Toggles the Insert/Overstrike mode.
Del	Deletes the character at the current cursor position.
Ctrl-Left	Moves the cursor one word to the left.
Ctrl-Right	Moves the cursor one word to the right.
Ctrl-End	Deletes all characters to the right of the cursor.
Backspace	Deletes the character to the left of the cursor.
Ctrl-Backspace	Deletes the word to the left of the cursor.
Tab	Inserts eight spaces in the command.
Escape	Clears the current command line.
Enter	Ends the editing and sends the command to DOS.
F3	Recalls the previous command without any search.
F7	Lists stacked commands on the screen.
F9	Selects stacked command by number.
Alt-F7	Clears the command stack.
Alt-F10	Clears the alias list

Figure 1: These are the default assignments for the PCMKEY command line editor.

mands. In PCMKEY, it's simple: You just use the Up and Down arrows regardless of whether you've already typed a few letters. If you've typed in some letters, the arrows let you search forward and backward for matching commands. If you've typed nothing, you will move forward and backward through all the buffered commands.

Like DOSKEY, PCMKEY lets you enter more than one DOS command at a time. Let's say you want to change the default disk and then change the default directory on the new disk. For example, you might type D: and then CD \WINDOWS\SYSTEM. With PCMKEY installed, you can put these two commands on one line using a command separator. PCMKEY is originally configured to use Ctrl-T as the command separator—the same separator used by DOSKEY—but later I will show you how to redefine the separator to any character. To combine the disk specification command with the change directory command, type

```
D: & CD \windows\system
```

The & character is displayed when you enter Ctrl-T. You can combine as many commands as you can fit on a 127-character command line.

ASSIGNING ALIASES One of the truly powerful features of PCMKEY is its ability to define aliases for frequently used commands. For example, the command

```
COPY c:\projects\data\*.* d:\projects\backup
```

can be a lot to type if used frequently. You can create a one-line batch file that executes the command, but this can waste disk space. Each file on your disk takes up at least one cluster; if you have ten one-line batch files and a cluster size of 8K (as you would with a hard disk partition larger than 256MB), those ten lines will take up 80K of disk space! PCMKEY gets around this problem by keeping all its aliases in memory, ready at a microsecond's notice.

To define an alias, enter the name of the alias and then the command you want to associate with the name. For example, to assign the alias BACKIT to the copy command shown above, you'd type

```
PCMKEY BACKIT copy c:\projects\data\*.* d:\projects\backup
```

After issuing this command, PCMKEY will substitute the copy com-

mand when you type BACKIT. (BACKIT is shown in uppercase so it will stand out, but aliases are not case-sensitive.) Aliases can be assigned after PCMKEY has been installed; typing PCMKEY again will not load a second copy of the utility.

You can use command line parameters and environment variables in aliases. PCMKEY uses the same number and environment variable syntax as DOS batch files; numbers are preceded by a percent sign, and environment variables are surrounded by percent signs. The additional parameter %* tells PCMKEY to substitute the entire command line for that placeholder. For example, to create an alias for adding a directory to your path, you could type

```
PCMKEY AP path=%path%;%1
```

With this alias, the command AP D:\UTIL would add the D:\UTIL directory to the end of the path. For aliases that do not specify parameters %1 to %9 or %*, PCMKEY automatically appends the command line to the end of the alias. For example, specifying the alias

```
PCMKEY T type
```

then typing the command

```
t autoexec.bat
```

would cause PCMKEY to append the remainder of the command line "autoexec.bat" to the alias, which results in the command

```
type autoexec.bat
```

Aliases also can contain multiple commands. As on the command line, each command is separated by a Ctrl-T.

To provide compatibility with DOS-

home	del	f3
up	bksp	f4
pgup	tab	f5
left	enter	f6
right	esc	f7
end	space	f8
down	f1	f9
pgdn	f2	f10
ins		

Figure 2: The names shown here are used when specifying keys that don't represent a character.

KEY, PCMKEY accepts the \$ parameters, such as \$0 to \$9, \$*, \$t, \$g, \$b, and \$l. Parameters \$0 to \$9 and \$* are interpreted the same way as %0 to %9 and %*. The parameters \$g, \$l, and \$b are translated into the greater than (>), less than (<), and bar (|) symbols that are used to signify piping and redirection to COM-

PCMKEY is its ability to reassign key combinations to particular text strings or commands. To assign a text string to a key, type PCMKEY followed by the key combination enclosed in square brackets [], followed by the text string. Character keys are represented by the character, such as "a" or "b". Other keys, such as

.COM, use the command:

```
PCMKEY [f10]* cls
```

Key combinations are defined by prefixing the key with an s-, c-, or a- to indicate a Shift, Ctrl, or Alt key combination. When assigning keys, use the unshifted character on the key to represent the key. For example, to assign a command to the plus (+) sign, use the unshifted character—in this case the equals (=) sign—accompanied by the Shift key modifier, as in:

```
PCMKEY [s-=] echo You pressed the  
equals key
```

You can also define your own prefix keys. This is useful for emulating editors that use combinations of keys, such as Ctrl-Q followed by another letter, to perform a function. PCMKEY supports up to three user-definable prefix key combinations. For example, define Ctrl-Q as a prefix key combination, you'd type

```
PCMKEY [c-q] [prefix1]
```

This defines Ctrl-Q as prefix sequence 1. Then, to associate Ctrl-Q followed by Y with a text string, you'd type

```
PCMKEY [1-y] This is a text string
```

The 1- prefix indicator refers back to Ctrl-Q, which you previously defined, and tells PCMKEY to check only for the "Y" key immediately after a Ctrl-Q is pressed. The three prefix commands are prefix1, prefix2, and prefix3; the modifiers are 1-, 2-, and 3-.

Most combinations involving a single Shift, Ctrl, or Alt and one key are supported, but PCMKEY's support of key combinations is limited by the key combinations supported by DOS. For example, since DOS does not support the Ctrl key in combination with the number keys 0 through 9, neither does PCMKEY. If you attempt to assign an unsupported key combination, PCMKEY will display the message "Unsupported key combination."

As Figure 1 shows, the editor in PCMKEY supports most popular editing functions. You can reassign PCMKEY's

Editor Function	Description
curleft	Moves the cursor one character to the left.
curright	Moves the cursor one character to the right.
srchcmd	Recalls the previous command using any partial command as a search template.
nextcmd	Recalls the next command in the stack using any partial command as a search template.
prevcmd	Recalls the previous command without any search.
home	Moves the cursor to the start of the command line.
end	Moves the cursor to the end of the command line.
toggleins	Toggles the Insert/Overstrike mode.
del	Deletes the character at the current cursor position.
prevword	Moves the cursor one word to the left.
nextword	Moves the cursor one word to the right.
del2eol	Deletes all characters to the right of the cursor.
bksp	Deletes the character to the left of the cursor.
tab	Inserts eight spaces in the command.
clrcmd	Clears the current command line.
wordbksp	Deletes the word to the left of the cursor.
enter	Ends the editing and sends the command to DOS.
dumpstack	Lists stacked commands on the screen.
pickcmd	Selects stacked command by number.
clrstack	Clears the command stack.
clralias	Clears the alias list.
abortcmd	Aborts the current entry and returns to COMMAND.COM.
prefix1	Defines first user-definable prefix key.
prefix2	Defines second user-definable prefix key.
prefix3	Defines third user-definable prefix key.
nop	Disables key.

Figure 3: This table lists the available editing functions in PCMKEY.

MAND.COM. If you specify an alias in a PCMKEY configuration file (configuration files are discussed below), you can dispense with these translations and use the >, <, and | symbols directly. This is because COMMAND.COM does not act on these characters in a configuration file.

The \$t parameter is translated into the command separator character, which defaults to Ctrl-T. If you redefine the command separator character, the \$t parameter will be translated to the new character. The \$t parameter should only be used when defining an alias or key assignment. When entering multiple commands on the command line, use Ctrl-T to separate the commands.

Another powerful feature of

Enter or Backspace, are referred to by the names shown in Figure 2.

To use the F3 key as a shortcut for the string *.* , the command would be

```
PCMKEY [f3] *.*
```

With this alias, you could type a command such as PKZIP ALLFILES, press the Spacebar to insert a space, and then press F3 to append the string *.*.

Normally, PCMKEY just inserts the text assigned to a key. But appending an asterisk (*) to the key specification causes PCMKEY to append an Enter keypress to the string automatically. To cause PCMKEY to enter the string CLS then automatically send it to COMMAND

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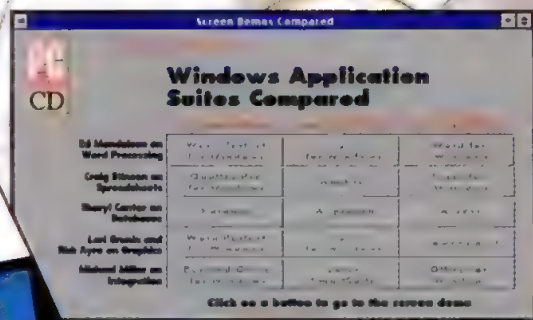
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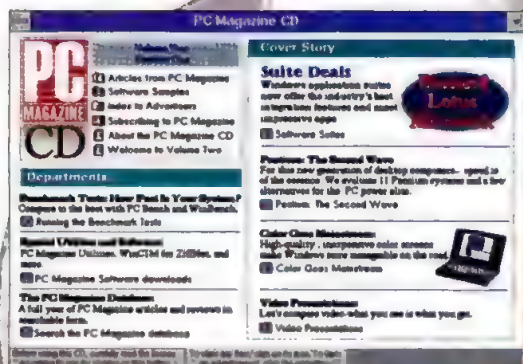
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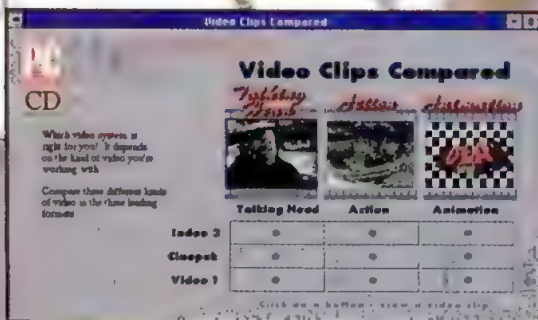
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editing functions to different keys so that it matches those used by your favorite editor. To assign an editor function to a key, type PCMKEY, then the key combination enclosed in square brackets, and then the editor function name enclosed in square brackets. The list of available editor functions is shown in Figure 3. For example, to assign the "Delete to End of Line" function to Ctrl-E, you'd type

```
PCMKEY [c-e] [del2eol]
```

One editor command I chose not to support in PCMKEY is the command to redirect the console to the printer. Under standard DOS and DOSKEY, Ctrl-P toggles redirection of the screen and keyboard to the printer. For those who need the Ctrl-P functionality, you should uninstall PCMKEY first.

THE COMMAND LINE SWITCHES PCMKEY supports 12 command line switches (not counting the comment indicators). The list of command line switches and their functions is shown in Figure 4.

Manually redefining a long list of keys each time you install PCMKEY would be inconvenient. This difficulty is solved by PCMKEY's /F command line switch, which tells PCMKEY to load the file following the /F switch into memory and treat each line in that file as a PCMKEY command. The /F switch is especially handy for redefining keys, but it can be used to issue any PCMKEY command.

For example, in keeping with the retro nature of this column, you might favor the ancient WordStar editor keyboard assignments. The following command loads and configures PCMKEY to use the WordStar editor keys:

```
PCMKEY /f wordstar.als
```

WORDSTAR.ALS is:

```
//-----  
// WordStar keys  
//-----  
[c-a][wordleft]  
[c-s][charleft]  
[c-d][charright]  
[c-f][wordright]  
[c-e][srchcmd]  
[c-x][nextcmd]
```

```
[c-v][toggleins]  
[c-g][del]  
[c-h][bksp]  
[c-y][clrcmd]  
  
[c-q][prefix1]  
[l-y][del2eol]  
[l-s][home]  
[l-d][end]
```

Any PCMKEY keyboard definition, command, or command line switch can be used in a PCMKEY configuration file. Notice that in a PCMKEY configuration file, you should not type PCMKEY on each line; this is assumed by the program. Also notice the use of the // to indicate a comment line (/ * can be used as well). Any characters after a comment indicator are ignored until the start of the next line in the file.

Normally, PCMKEY uses an underline cursor to indicate overstrike mode, and a block cursor to indicate insert mode. This configuration is backward-compatible with ALIAS and Jeff's original DOSKEY. Issuing the PCMKEY command with the /C switch reverses these settings, making the insert mode use an underline cursor and overstrike mode use the block cursor; this is more in keeping with the design of modern word processors. The /C switch is a toggle, so issuing it again will return PCMKEY to the original setting. The cursor shape changes each time you use the /C switch.

The /D switch disables PCMKEY alias translation. The command line editor and stacking functions of PCMKEY still work, but aliases are not translated before sending the command to DOS. This is handy when you are using someone else's machine with PCMKEY installed. Instead of trying to adapt to a new set of aliases, you can simply disable them until your work is done. The /E switch re-enables alias translation.

The /I switch tells PCMKEY whether it should match the case of a command when searching for it in the command stack. The /I switch is followed by either a plus (+) or a minus (-) character. The plus indicates that case should be checked; the minus tells PCMKEY to ignore case. By default, PCMKEY is case insensitive when searching the stack.

The /M switch followed by a number sets the minimum length a command must be before it is saved in the command stack. This prevents short commands such as DIR from cluttering up the stack. For example, the command

```
PCMKEY /M4
```

tells PCMKEY not to store any commands of length less than four.

The /P switch lets users define the character used to separate multiple commands on the command line. The separator character must immediately follow the /P switch. This command globally changes

Syntax:
PCMKEY [alias [command]][/B n][/C][/D][/E][/F filename]
[/I+|-][/K][/L][/M n][/Pc][/S n][/U]

```
PCMKEY alias command
```

```
PCMKEY [key] [function] or command
```

```
/B = Set buffer size*  
/C = Toggle underline cursor for insert  
/D = Disable alias translation  
/E = Enable alias translation  
/F = Define filename of command file  
/I+ = Ignore case in search  
/I- = Match case in search  
/K = List key assignments  
/L = List aliases  
/M = Minimum command length to stack  
/P = Define command separator*  
/S = Set size of command stack*  
/U = Uninstall
```

* Switches valid only at install time.



Figure 4: PCMKEY supports 12 command line switches; 3 of the switches can be issued only when PCMKEY is first launched.

the separator, so aliases that expect another separator character will fail. The /P switch can be used only when PCMKEY is being installed.

When PCMKEY is installed, it reserves enough memory to contain all the aliases defined during installation. (Multiple aliases can be defined during installation if the /F switch is used to read a file of PCMKEY commands.) The /B switch tells PCMKEY how much extra memory

command would be

PCMKEY /B 512

stalled. For example, the command

PCMKEY /S 16

was fixed as the command length.

redirect the listings to a file, as in

```
PCMKEY /K >keylist.pcm
```

file the next time you start PCMKEY.

be removed from memory.

be helpful.

code and the transient code. The resident

```

StartupInfo      struct
    sisVersion    dw      3      ;Switcher structure ID
    sisNextDev    dd      0      ;Ptr to prev startup structure
    sisVirtDevFile dd      0      ;Ptr to name of opt dev drv'r
    sisReferenceData dd      0      ;Data for Win dev driver
    sisInstanceData dd      0      ;Ptr to instance mem list
StartupInfo      ends

Block1Ptr        dd      0      ;Ptr to instance data
Block1Size       dw      0      ;Size of instance data
Block2Ptr        dd      0      ;Ptr to instance stack
Block2Size       dw      0      ;Size of instance stack.
.
.
.
                dd      0      ;Ptr to next block = 0 to
                dw      0      ; terminate list.

```

Startup into structure like this one in its own memory.

valuable conventional memory.

PCMKY in memory.

in memory, a technique available since

lines the next ID number, continuing until

sage.

used as PCM-

AL to a nonzero value, and returns.

multiplex (Int Zfh).

called, of COMMAND.COM did not

make the call, the interrupt is simply passed on to DOS for processing.

Determining whether COMMAND.COM made the call is done by examining the Parent PSP field (offset 16h) in the active program. If the segment of the PSP itself is in the parent field, then the call is from a command processor such as COMMAND.COM. The PSP of the active program is determined by calling the DOS Get PSP function (Int 21, AH = 62h).

IT'S A WINDOWS WORLD Unlike ALIAS, PCMKEY is fully Windows-compatible. Unless you added ALIAS's name to the LocalTSRs line in the NonWindows-App section in SYSTEM.INI, ALIAS didn't run under Windows at all. The problem was that ALIAS didn't check for Windows, so it would overwrite its own stack if more than one DOS box was opened.

The LocalTSRs line is a work-around in Windows for TSRs such as ALIAS that don't check for the presence of Windows. When Windows starts, it compares the names of the installed TSRs with the LocalTSRs list. If a match is found, Windows creates separate copies of the TSR's memory blocks for each DOS box that is opened in Windows. Each separate copy has its own stack, and therefore can't overwrite itself.

The problem with this work-around is that Windows doesn't know which areas of the TSR are critical and wastes space by duplicating the entire TSR in each DOS box. A better solution is to make a TSR Windows-aware. Windows 3.x provides a means for TSRs to duplicate critical sections of themselves in each DOS box while sharing most of the code and data sections across all DOS boxes. This is accomplished through an interface available to DOS programs for requesting portions of memory to be unique to each DOS box. This memory is called "instance memory" since it is unique to each instance of the program.

Instead of calling Windows to request this memory, a program supplies the instance information when Windows starts. To see if Windows is starting, it monitors the multiplex interrupt and checks the contents of AX. If AX is loaded with 1605h, it indicates that Enhanced mode Windows is starting; if AX is loaded with 4B05h, it indicates that standard mode Windows or the MS-DOS Task Switcher is starting.

Relating back to our discussion earlier, AX=1605 can be interpreted as Device ID 16, Function 5. Device ID 16 is documented in the Windows Technical Reference as reserved by Windows. Function 5 is the Windows startup notification. Device ID 4B is reserved for the DOS Task Switcher, which also uses Function 5 to indicate it is starting.

If one of these notifications is detected, the program first calls the old interrupt vector to pass on the notification. This allows TSRs loaded before PCMKEY to see the Windows Startup Notification. When the call returns, ES:BX is pointing to the instance memory structure created by the next TSR in the chain.

The next step is to add PCMKEY to the chain of TSRs. The pointer in ES:BX is then saved in the sisNextDev field of a StartupInfo structure like the one in Figure 5. Each TSR that needs instance memory must create one of these StartupInfo structures in its own memory. The routine must then return from the multiplex interrupt with ES:BX pointing to its own StartupInfo structure. If another TSR that needed instance memory were loaded after PCMKEY, it would then store in its StartupInfo structure the value in ES:BX returned by PCMKEY.

When the interrupt finally returns to Windows, ES:BX contains a pointer to a StartupInfo block that contains, in the sisNextDev field, a pointer to the next StartupInfo block. This in turn points to the next StartupInfo block, and so on. This method builds a chain of StartupInfo structures that Windows can use to find the instance-memory blocks necessary for all installed programs.

The StartupInfo structure contains a number of other helpful fields. For example, sisVirtDevFile and sisReferenceData are fields that let a TSR tell Windows to load a VxD—useful when a VxD can better accomplish the TSR's function while Windows is running. The sisInstanceData field points to a list of the locations and sizes of requested instance-memory blocks. Each entry contains a far pointer to an instance-memory block and a word value that holds the size of the block. If you have a block larger than 64K, you will need more than one entry in the list to encompass the entire block. The list is terminated with an entry that contains zeros

in both the address and size fields.

Determining what data should be instanced is not difficult. The key is to instance any data values that are nonreentrant—that is, data that would be corrupted if the TSR were called while another copy of the TSR was also running. For PCMKEY, this includes the internal stack, the temporary buffers used by the editor, and any configuration values that might differ among DOS boxes.

PCMKEY ENHANCEMENTS The biggest changes to PCMKEY were the redesigned command stack and the definable key function. The command stack in both Prosis's DOSKEY and ALIAS used an array of fixed-length buffers that held the stacked commands. Since the entries in the array must be able to hold a maximum-length command line of 127 characters, the array was quite large when the stack was defined to hold more than a few commands.

The command stack in PCMKEY is implemented as a list of variable-length strings inside a fixed-length block. Each stacked command consists of a length byte followed by an ASCIIZ string containing the command. Since each entry in the list is only as large as the command itself, this design is much more memory-efficient than the original array design. Fortunately, the command stack routines in the original ALIAS were relatively isolated—so the redesign in this area did not affect the design of the remainder of PCMKEY.

The assignable key feature was only a little more complex. The installed portion of the code is actually quite simple. The command line editor reads a key from the keyboard, checks it against a list of keys with assigned functions, and calls the appropriate function if the key is on the list. If it's not on the list, the editor simply displays the character on the screen. The exceptions are extended keys (such as function keys), which are not displayed when they're not on the list.

The complex part of the key-assignment feature is the mechanism used to assign the keys to their functions. After considering several designs, I decided on a brute-force table-lookup approach. A list of keys—designated by their associated characters or their names (see Figure 2)—is searched whenever a key is assigned to a function. When found, the key's offset in the list is used as an index into a table of

key codes. The resident portion of PCMKEY uses the key code in the list of assigned keys.

For the routine that lists the keys and their assignments, the process is reversed. Keys are read from the list in the resident code and compared against the lookup table. The index in the lookup table where the key code is found is then used as an index into the list of names for the

keys, which is then displayed to the user.

The table-lookup design has the advantage of being simple to program and fast to execute. The disadvantage is the large size of the key-code lookup table. But since the lookup table and interface routines are in the transient portion of the TSR, they don't affect the amount of memory the TSR uses when installed.

The command line was in use long be-

fore DOS, and it looks like it will be around for the foreseeable future. As long as there are command lines, command line editors will be popular. PCMKEY is a 1990s refinement of this type of utility. If you are still hooked on the command line, bring yourself up to date with PCMKEY. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR OF PC MAGAZINE.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

PCMKEY

PURPOSE: PCMKEY provides command stacking and alias translation for COMMAND.COM or other DOS command interpreters. Editing keys can be defined to suit the user.

SETUP: To install PCMKEY, type PCMKEY at a command line prompt. The command line switches are:

/B = Set buffer size*
/C = Toggle underline cursor for insert
/D = Disable alias translation
/E = Enable alias translation
/F = Define filename of command file
/I+ = Match case in search
/I- = Ignore case in search
/K = List key assignments
/L = List aliases
/M = Minimum command length to stack
/P = Define command separator*
/S = Set size of command stack*
/U = Uninstall

*Switches valid only at install time.

REMARKS: To create an alias, type the one-word name of the alias followed by the text to substitute for the alias. To assign a key, specify the key enclosed in square brackets followed by the text to insert or an editor command also enclosed in square brackets. The allowable editing commands are shown in Figure 3 in the main article. Keys are specified by their lowercase letter (for alphabetic keys) or by their name. Figure 2 gives the list of key names recognized by PCMKEY. Text aliases can include command line parameters and environment variables. Command line parameters are specified by %0 through %9; environment variables are enclosed in % signs. Multiple commands can be specified in an alias using the \$t separator. If an alias is specified on the command line, the redirection and piping symbols >, <, and | can be specified using the \$!, \$g, and \$b parameters.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

HARDWARE

Mirror for One

❓ Is there any software that will let me mirror one IDE hard disk to a second physically identical one in the same PC? I'm currently running without any backup, so please help.

Brian Berlin
Tucson, Arizona

► **PC MAGAZINE:** First things first—*make a backup!* You'll need one anyway if you attempt the suggestion that follows, so do it sooner rather than later.

Network servers often provide the system with a level of fault tolerance by implementing *disk mirroring*. This technique uses one disk controller (generally in conjunction with software, although some intelligent controllers can mirror on their own) to control two hard disks. All writes to the primary drive are duplicated—mirrored—on the second simultaneously. Mirroring typically uses both disks at the same time, but if the controller detects an error on one, the system will alert the user and continue using the good drive until the server can be brought down to repair the damaged unit. (This differs from disk arrays, which can spread data redundantly over a number of drives so that if one fails, the data can be reconstructed from the remaining drives.)

I'm not aware of any software that will mirror disks in a single-user system, but there is a relatively inexpensive hardware solution—and since hard disk prices have fallen so much, it can make sense to use mirroring on a single-user system. Silicon Valley Computer (415-967-1100) makes the Silicon Valley IDE Mirror Card (\$195 list), which will mirror one or two pairs of physically similar IDE drives. (For a re-

view, see First Looks, June 29, 1993.)

The problem with mirroring is that it protects only against a significant failure in one disk drive. The controller may misidentify which disk is the source of a subtle failure and shut down the wrong one. Also, if the controller or some other component should fail, you can still lose access to your data. If you depend on the data in your computer, there's no substitute for a system of rotating backups and off-site storage.

And speaking of backups: Running without one is an unnecessary invitation to disaster, since a simple DOS command can give you somewhat the same result as disk mirroring. Suppose your primary drive is C: and your (identical or larger) secondary is D:. From the root directory of drive C:, type XCOPY *.* D: /S /E at the DOS prompt and the contents of C: will be copied to D: (except for hidden and system files under DOS 5.0 and later versions). /S causes subdirectories to be copied, and /E makes sure that even empty ones are duplicated. After the first time you run XCOPY, you might add the /M switch (DOS 5.0 and above) to speed up the process. This will copy only files with the archive attribute set and then clear the attribute on the source files, so only changed files will be copied. Set this

up to run at the end of the day; then turn off the monitor and head home. When you come back the next morning, your data will all be safely stored on the backup disk.

One warning: Files you delete on C: will not be deleted on D:. Thus (depending on how much you move and delete files on C:), drive D: will eventually fill, causing XCOPY to give a Disk Full error. When this happens, you'll have to delete everything on D: and repeat the initial XCOPY (without the /M switch).

—Alfred Poor

OPERATING ENVIRONMENTS

Viewing Arbitrary File Types in File Manager

❓ When using File Manager, I'd like to at least see the contents of the file instead of the Cannot Run Program dialog box when I double-click on a data file that has no program associated with it. Is there any way to create a default association for all unassociated extensions so that a double click on, say, any .G67, .PEC, or .TMP file would call up my favorite viewer?

Les Klassen Hamm
Saskatoon, Saskatchewan, Canada

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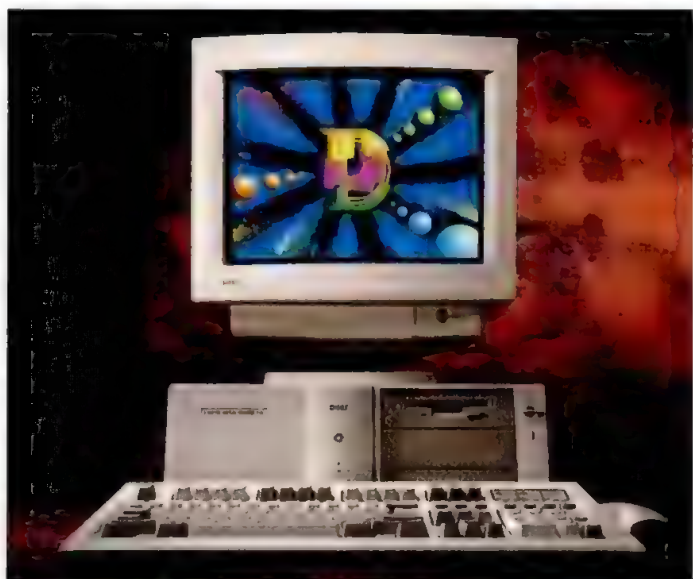


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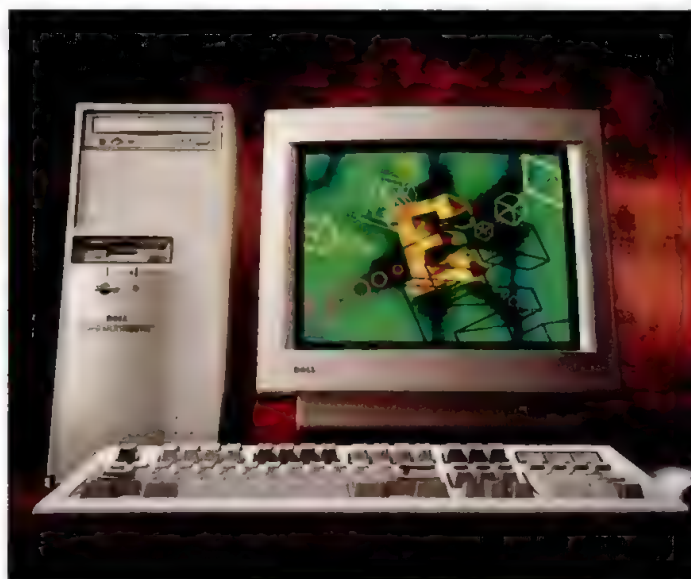


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► **PC MAGAZINE:** Alas, Windows' file association system works strictly on unambiguous file extensions—no logical operations and no wildcards allowed. You can't, for example, use a line like `???=WRITE ^.??? in WIN.INI's [Extensions] section`. Neither can you add `???` or `*` as a key in the Registration Editor. There's something you can do, however, that's almost as straightforward as defining a default association.

Open the File Manager and double-click on the icon for the drive that contains your viewer. In the new window that appears, move to the directory that holds the viewer; we'll use `WRITE.EXE` as an example. Now you'll make several trips to the File Manager's View menu. Choose Directory Only on the first and Name on the second. Select By File Type the third time, which will cause a dialog box to pop up. Enter `WRITE.EXE` in the name field and ignore the check boxes.

You should now have a File Manager window that contains nothing but `WRITE.EXE` and the parent-directory symbol. Shrink this window to its smallest dimensions, then stretch it vertically until `WRITE.EXE` just barely shows. You

won't be able to get rid of the drive icons, unfortunately, but you will lose the horizontal scroll bar and buttons. Place the window in a handy corner of the File Manager's workspace (but not on top of another directory window) and make sure Save Settings On Exit under the Options menu is checked.

Now enjoy the fruits of your labor! From the original main directory, drag any file (regardless of its extension) and drop it on the viewer in the tiny window. That's almost as easy as double-clicking. Just be careful to drop the file directly on the viewer's name or icon; otherwise, you

may accidentally move the file. If you don't want File Manager to ask for confirmation before starting the viewer each time, select Confirmation under the Options menu and uncheck the Mouse Action check box—but be careful after! This change applies to all File Manager windows and lets you easily start unintended actions.—Neil J. Rubenking

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M. David Stone is a contributing editor and coauthor of *Word for Windows Companion*, Second Edition.

Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities*.

Bypass Surgery for DOS 6.x

❓ I'm in the process of setting up a small network and for security reasons need to prevent users from bypassing the start-up files on their machines. We use DOS 6.2, though, which lets anyone either bypass `CONFIG.SYS` and `AUTOEXEC.BAT` by pressing the F5 key or step through them by pressing F8. Is there anything I can do?

Kevin A. Kobb
South Bend, Indiana

► **PC MAGAZINE:** If a line in your `CONFIG.SYS` locks up your computer, you can fix the problem only by booting without `CONFIG.SYS`. Wise users of earlier DOS versions always kept a clean boot disk on hand—a formatted floppy disk containing system files and possibly a text editor. You don't need one, though, for DOS 6.x. Pressing F5 during the boot process makes it ignore `CONFIG.SYS` and `AUTOEXEC.BAT`. Press F8 and DOS asks for confirmation before loading each `CONFIG.SYS` line and before running `AUTOEXEC.BAT`. In DOS 6.2 or later, you also get to pass judgment on individual AUTO-

EXEC.BAT lines.

As you note, though, this feature allows users to circumvent security files loaded by CONFIG.SYS. To disable the feature, include the line `SWITCHES=/N` anywhere in your CONFIG.SYS. That's all! The "Starting MS-DOS..." message will still appear, but pressing F5 or F8 will have no effect. Of course, now you'll need to keep a bootable floppy disk in a secure location for emergencies.

If you're using DoubleSpace under DOS 6.2, a related feature lets you disable the loading of DBLSPACE.BIN. This is useful if the compressed partition becomes corrupted. Simply press Ctrl-F5 when you see the "Starting MS-DOS..." message during the boot process. In the unlikely event you want to disable this feature, you must go to DOS and enter `DBLSPACE /SWITCHES=N` at the command line, then reboot the machine. This puts the line `SWITCHES=/N` in the DBLSPACE.INI configuration file. To re-enable the feature, you must delete that line from DBLSPACE.INI and reboot.

—Neil J. Rubenking

WORD PROCESSING

Searching for Exotic Characters in WordPerfect

TIP If you've ever found odd characters in files you've imported into WordPerfect 5.1, you've probably struggled with how to rid your files of those characters—either by deleting them or by replacing them with something else. The obvious way is to use WordPerfect's search-and-replace feature, but if the characters in question are not on your keyboard, you may not know how to enter them. Here's an easy way to search for any character or group of characters.

First, block the character by placing the cursor on the character, pressing Alt-F4 to turn on block mode, and pressing the Right Arrow key. Next, press Ctrl-PgUp so you can define the blocked character as a variable. Enter any number—1 in this example—and press Enter

to finish the variable definition.

You can now use WordPerfect's search-and-replace feature as usual, entering the variable you just defined as the item to search for. Press Alt-F2 and answer the Confirm prompt Yes or No as appropriate, then press Alt-1 to enter the variable you just defined. Press F2 again, enter the replacement character or characters (if any), and press F2 once more to start the search-and-replace. At no point do you have to know how to create the character you defined in the variable.

Ronald B. Whisenhunt
La Jolla, California

PC MAGAZINE: This technique works just as well in WordPerfect 6.0, though some of the keystrokes are slightly different. Most important, when you press Ctrl-PgUp in WordPerfect 6.0, you get the Macro Control dialog box; Assign Variable is one choice. Choose A (for Assign Variable) and WordPerfect will take you to the Assign Variable dialog box. There you can assign the variable using a number key and press Enter twice to return to

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the editing screen. The other major difference, of course, is that WordPerfect 6.0 offers a dialog box for search-and-replace rather than a series of prompts on the bottom line of the screen.

It's worth noting too that you can usually find out what the exotic characters are easily enough. Most often, they will be characters that WordPerfect interpreted as compose characters during the import. To find out if a given character is a compose character (and if so, which one), simply press Alt-F3 to open the Reveal Codes screen and move the cursor directly over the character. If it's a compose character, you'll see the compose code in the form [X:A,B], where X is the character, A is the number of the character set, and B is the number of the character within the character set.

Once you know the code for the character, you can enter it directly as the item to search for—either in response to the Srch: prompt in WordPerfect 5.1 or in the Search For text box in WordPerfect 6.0. To enter the character in WordPerfect

Most of the time, exotic characters are a result of WordPerfect mistakenly interpreting them as compose characters during the import.

5.1, press Ctrl-V, then enter the character set number, a comma, and the character number. To enter the character in WordPerfect 6.0, press Ctrl-A, and then enter the character set number, a comma, and the character number.—M. David Stone

SPREADSHEETS

Keeping Excel Functions Private

My Excel macros use a lot of custom functions written in Microsoft Visual Basic, Applications Edition. Since these functions are not designed to be used on

the worksheet, I would rather they didn't show up in the Function Wizard's list of user-defined functions. Is there a way I can prevent them from appearing in that list?

*Tazyeen Ahmed
Karachi, Pakistan*

►PC MAGAZINE: Yes, declare them with the keyword `private`. A function that looks like

```
Private Function MyFunc()  
    (statements)  
End Function
```

will not appear on the Function Wizard's user-defined function list.—Craig Stinson

Multiple Series in Excel 5.0 Charts

I'm a CA-SuperCalc 5.x user, but I've been considering a move to Excel. One need I have is to plot multiple curves on a single x,y graph. Figure 1 shows a typical example.

There are three x,y series here, each with different x values. Two of the series are set up in columns, and one is in rows. Each series has a different number of data points.

This is easy to do in SuperCalc. How is it done in Excel?

*Sal A. Leone
Schenectady, New York*

►PC MAGAZINE: For a worksheet laid out as shown in your letter, you could proceed as follows:

- Build an x,y graph for the first series. There are several ways to do this in Excel.

One way would be to select A3:B7, choose the Chart command on the Insert menu, and choose As New Sheet. When the Chart Wizard's first dialog box appears, click Next. In the Chart Wizard's second dialog box, choose XY (Scatter) and click Next. In the wizard's third dialog box, select the style of x,y chart you want and click Finish.

- Return to your worksheet and select C3:D5.

- Choose the Edit menu's Copy command.

	A	B	C	D	E
1	X1	X2	X3	X4	
2					
3	1.1	1	0.5	0.5	
4	2.3	4	0.75	1.5	
5	3	5	6	12	
6	4.1	9			
7	4.5	14			
8					
9					
10	X3	3	5.2	7	10
11	Y3	1.7	2.5	3.5	6
Curve 1 = A3:B7					
Curve 2 = C3:D5					
Curve 3 = B10:E11					

Figure 1: Here are the ranges for three x,y charts in CA-SuperCalc 5.x.

- Go back to the new chart sheet and choose the Edit menu's Paste Special command.
- In the Paste Special dialog box, choose Add Cells as New Series, Values (Y) in Columns, and Categories (X Values) in First Column. Then click OK.
- Return to the worksheet again and select B10 to E11.
- Choose the Edit menu's Copy command.
- Return to the Chart sheet and choose the Edit menu's Paste Special command.
- In the Paste Special dialog box, choose Add Cells as New Series, Values (Y) in Rows, and Categories (X Values) in First Row. Then click OK.

Figure 2 shows the resulting graph. I've thickened the plot lines to make them easier to see in the screenshot, but the graph is otherwise unaltered. From here, you can tailor the appearance of the chart to suit your needs.

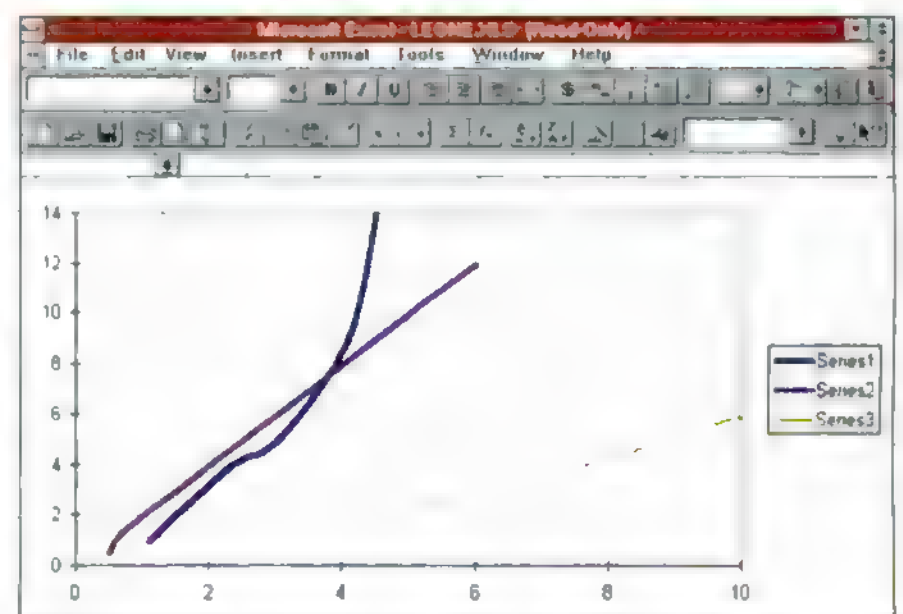


Figure 2: With the help of Excel's Chart Wizard, the three series in Figure 1 were plotted to look like this.

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**Mismatched
Michael**
PCMCIA slot
wasn't
his type

**Flat
Fred**
Run over
on the
information
highway

A Halloween-themed graveyard scene. In the foreground, a black wrought-iron fence runs across the bottom. Behind it, several tombstones are visible. On the left, a tombstone for 'Drained Darryl' has a small, glowing, winged figure perched on it. In the center, a tombstone for 'Businessman Bob' is partially obscured by a large, white, sheet-covered ghost figure with its arms raised. To the right, a tombstone for '286 System' is visible. The background is a dark, blue sky with bare, leafless tree branches. The overall lighting is dim, with some highlights from the glowing figure and the ghost's sheet.

**Drained
Darryl**

The battery life
on his Elite
lasted longer
than he did

**Businessman
Bob**

Died from
watching one
to many
reser

286 System

Survived by
loving 386, 486
and Pentium
relatives



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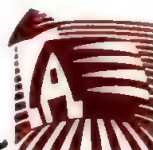
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	A	B	C	D
1	1.1	1		
2	2.3	4		
3	3	5		
4	4.1	9		
5	4.5	14		
6	0.5		0.5	
7	0.75		.15	
8	6		12	
9	3			1.7
10	5.2			2.5
11	7			3.5
12	10			6

Figure 3: If you arrange the chart series in this way, you can plot multiple series on one chart—in one step.

You could get the same graph by setting up your worksheet a little differently. Put all the x values into a single column and the y series in three adjacent columns so that your worksheet looks something like Figure 3. With this layout, you can simply select A1:D12 and plot all three curves at once, following step 1 above. Note that the x values in column A do not need to be sorted. In fact, they should not be. If you sort them, you'll have discontinuities in your three y series, which will give you discontinuous curves.

—Craig Stinson

■ DATABASES

Counting Groups in FoxPro Reports Revisited

TIP In your August 1993 issue, you published several techniques for counting the number of groups in a FoxPro report. Another alternative is shown in Figure 4. Here, as with the techniques you presented earlier, I use two report variables and the Reset at Group feature from FoxPro's report writer. My Value to Store expression is simpler, however, than in your method.

H. B. Touw
Jakarta, Indonesia

Name	Value to store	Initial value	Reset	Calculate
nGroupcnt	nGroupnew	0	End of report	Sum
nGroupnew	0	1	Region	Nothing

Figure 4: Here is an approach to counting groups in a FoxPro report. The nGroupcnt report variable holds the number of groups at the end of the report.

code that calculates the number of groups or used report variables in the report writer.

You'll recall that a report variable is a memory variable that FoxPro creates and maintains while generating a report. When you create a report variable, you assign it a name, a value to store, an initial value, a point at which it's reset to the initial value, and a calculation to perform. You also tell FoxPro whether or not to release the variable when the report finishes.

FoxPro initializes the report variable to the value that you specify. Then for every record in the detail band of your report, FoxPro evaluates the Value to Store expression, supplies the result to the calculation you specify, and then stores the result of that to the named variable.

To group records in a FoxPro report, you specify a group expression, such as the Region number used in the example. FoxPro prints detail records until it detects that the result of the group expression has changed, at which point it starts a new group; that is, it prints the group footer band, prints the group header band for the new group, and so on. To count the number of groups in a report, you must detect when the value of the group expression changes.

Mr. Touw does this using the nGroupnew report variable. This variable is reset to 1 when the Region changes but remains 0 at all other times. Thus, if there were 30 records in your table for three different regions, 3 times nGroupnew would be set to 1, and 27 times it would be set to 0. Mr. Touw uses a second report variable, nGroupcnt, to sum all of these nGroupnew values. Thus, nGroupcnt contains the number of groups, 3, at the end of the report.

Note that if you do not select Release After Report in the Variable Definition dialog box, the nGroupcnt variable remains defined after the report finishes. You can then use it in other reports or analyses.—Sal Ricciardi

► **PC MAGAZINE:** The techniques presented in the August 1993 issue either preceded the report form command with

Message Clauses in FoxPro for DOS Menu Builder

TIP FoxPro for Windows' Menu Builder allows you to add a MESSAGE clause to menu prompts, but FoxPro for DOS doesn't offer this feature. There is, however, a simple way to use a MESSAGE clause in FoxPro for DOS's Menu Builder. Just add your message to the menu Prompt in the following format:

Prompt * MESSAGE * your message

For example, if the first prompt on your menu is File, the Prompt line

\<File * MESSAGE * The File Menu

will do the trick.

Russell S. Brown
Bedford, Texas

► **PC MAGAZINE:** For some reason, the DOS version of FoxPro does not have a MESSAGE check box in the Prompt Options dialog box. If you use Mr. Brown's method, however, you can embed your message clause right into the menu prompts themselves. You must be careful to use the exact syntax shown in the example above. Otherwise, FoxPro for DOS might not generate the correct code.

Note that when you use this technique and choose the Try It button in the Menu Builder, FoxPro considers your entire prompt text, including the message portion, to be part of the menu pad. This behavior is limited to the Try It button in the Menu Builder, however. FoxPro correctly processes the message clause in your compiled code.—Sal Ricciardi

■ GRAPHICS

Separations for Silkscreens

❓ I'd like to know if there is an easy way to create separations from scanned images using custom colors. I've used Photoshop to generate traditional four-color separations, but because I want to use

these separations for silkscreening rather than offset printing, I am not limited to the CMYK range. Any ideas?

Mark Bush
Clearwater, Florida

► **PC MAGAZINE:** If you want to generate color separations using custom or spot (instead of CMYK) easily, your best bet is to wait for the release of a product called PhotoSpot, from Second Glance (714-855-2331). Currently this program runs only on the Macintosh as a Photoshop Plug-In, but Second Glance plans to ship a Windows version by the end of this year at a price of \$199.

Before you can actually generate spot color separations, you must squeeze the thousands—or millions—of colors that are typically found in a 24-bit RGB image down to the four or six or ten colors of your silkscreen. PhotoSpot provides several different tools to help you reduce colors intelligently. For example, using the PaintThinner feature, you can select a range of similar colors and map them to a single spot color. PhotoSpot allows you to output the color-reduced image either as a series of black-and-white bitmaps or as a multiplane EPS file that can be printed from QuarkXpress or Aldus PageMaker. One of the truly neat things about PhotoSpot is its status as a Photoshop Plug-In, which means you can use it with any Plug-In-compatible product, like Aldus PhotoStyler, Micrografx Picture Publisher, and of course Adobe Photoshop.

On the other hand, if you want to generate spot color separations now, you can use almost any image editing software program. First you color-reduce a picture from 24-bit mode to a limited palette (referred to as *indexed color mode*) and then manipulate the color palette to generate a series of single-color bitmap files. Here's the process—which is actually more tedious than difficult:

First, you'll want to transform the continuous tone information into broad areas of flat colors that are more suitable for silkscreen reproduction. The Posterize command (found on the Image/Map menu) lets you reduce the number of brightness levels in an image and then maps all the pixels in a picture to the brightness level that is the closest match.

A low value produces pictures with fewer colors and large flat areas of color. So setting this command to a value of 4 is usually the best way to start.

Now use the Mode command to convert the RGB picture into an indexed color file. The Indexed Color dialog box contains a number of different options. Better yet, Photoshop will always take its best guess at the optimal settings, and in many cases the default settings work best. In the sample dialog box shown in Figure 5, Photoshop can create an indexed color file that is an exact match using only 49 colors. Notice that Photoshop also prompts you to create a custom palette containing only those 49 colors.

Less perfect but still workable would be to reduce a full-color picture to 8 bits using an adaptive palette and no *dithering* (a process by which pixels of two different colors are interspersed to create a new, intermediate color). This will generate a 256-color file in which the colors in the palette are based on the colors in the picture rather than the Windows' default palette.

You must now manually reduce the number of colors in the picture by selecting similar colors and filling them with a single solid shade. Use Photoshop's standard selection tools, like the lasso or magic wand, to do this. Remember: If you want to select every instance of a particular color no matter where it appears in your picture, you have to select it only once and then invoke the Similar command from the Select menu. Even though Photoshop's selection tools are the best around, this is slow, tiresome work. And I guarantee that at some point you are going to have to clean up stray pixels using the paint brush.

Even if your image contains only a handful of colors, the palette will still contain a broad range of hues. Here's a trick to get the picture and the palette back in sync. Temporarily return to RGB mode by selecting it from the Mode menu. Then reselect Indexed Color. This time, Photoshop should produce a picture—and a palette—with the exact col-

ors you want to use in your silkscreen.

By the way, flipping between color modes is not a recommended practice. Each time Photoshop maps the image between two different color modes there is the potential for a color shift. This could be a major problem if you need to generate CMYK separations. In your case, however, you'll be substituting your own custom inks for the colors that appear on-screen, so the issue of color-matching the screen image to the final printed piece isn't relevant.

To generate the actual spot color separations, you'll want to print only one

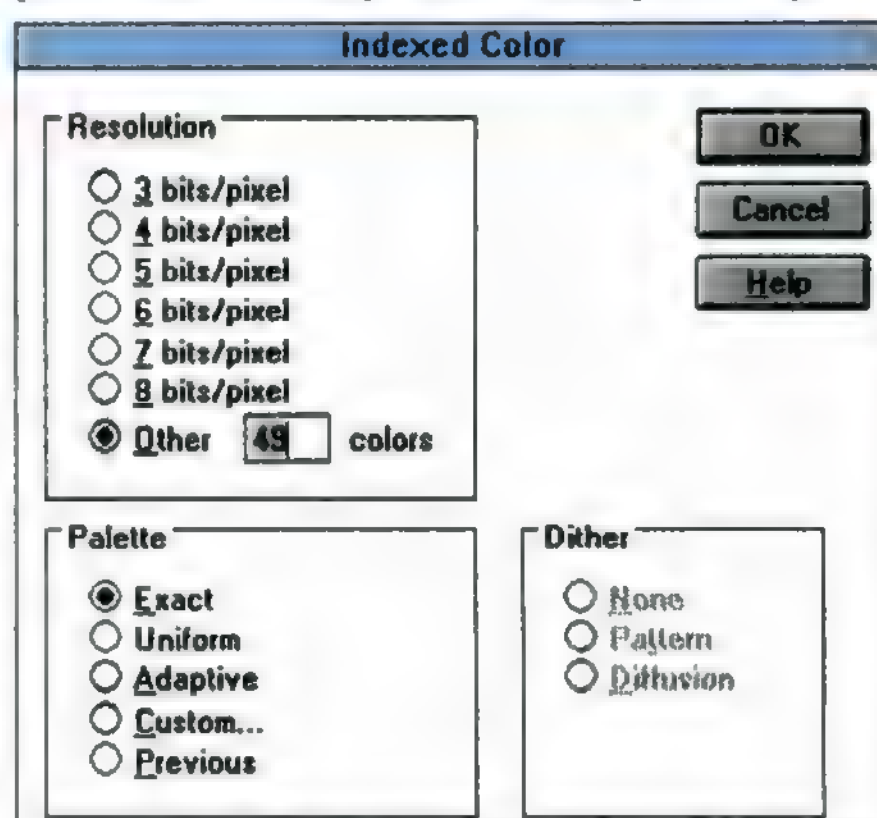


Figure 5: Photoshop's Indexed Color dialog box allows you to choose the color-reduction options that will produce the most accurate version of the current image and the most efficient palette.

color at a time. You can accomplish this most easily by manipulating the palette itself. Open the palette by clicking on the Color Table command in the Mode menu. Now select each of the colors you don't want to print on this go-around and make them white (the color of your paper). Select the one color you do want to print and make it black. When you return to your picture, you'll have a black-and-white separated image for one of the colors in the picture. Save this file with a filename that will remind you of the color it represents, perhaps PURPLE.TIF. Repeat this process for each color in your image.

You can now print each individual file as either positive or negative film, and you can use that film either to expose or to cut your screens.—Luisa Simone

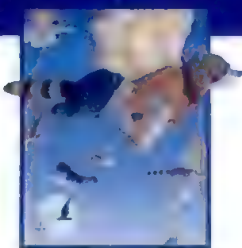


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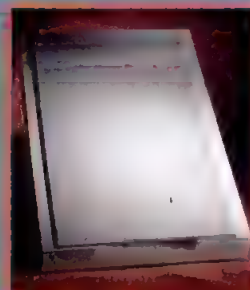
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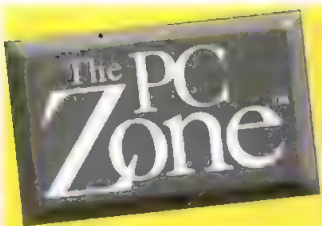
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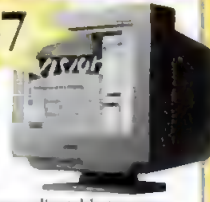
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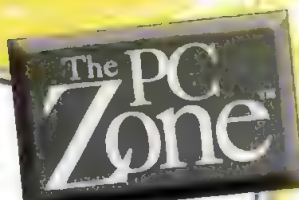
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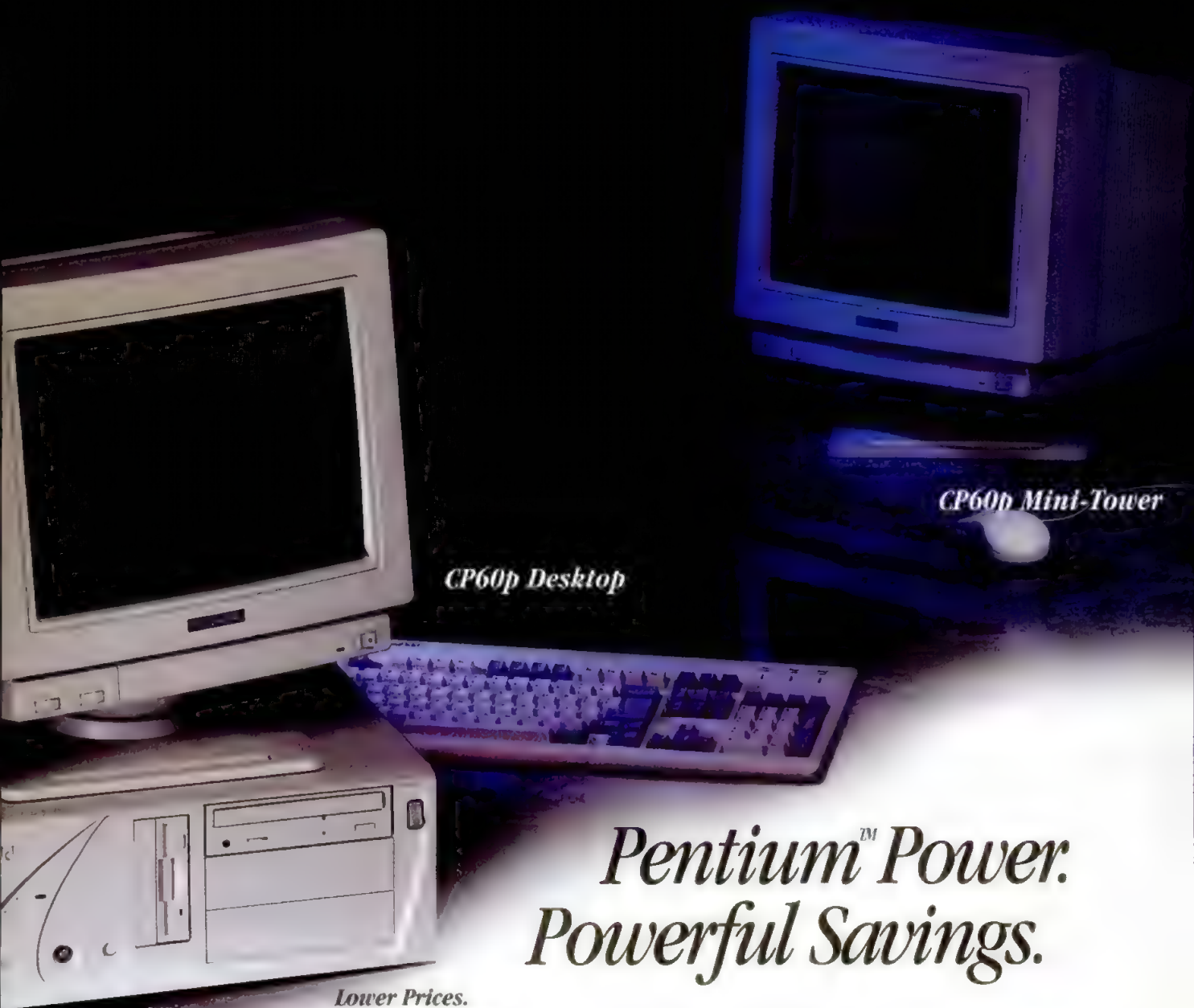
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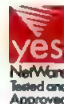
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RAM	8MB	8MB	8MB	16MB
Cache	256KB	256KB	256KB	256KB
Hard Drive	212MB	420MB	420MB	1GB
Expansion	8 Slots, 3 with PCI	8 Slots, 3 with PCI	8 Slots, 3 with PCI	8 Slots, 3 with PCI
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Video	1MB PCI	1MB PCI	1MB PCI	1MB PCI
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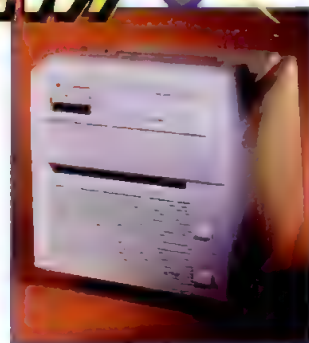
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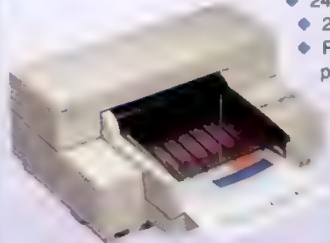
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Pocket Token Ring II	465.89
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IBM TOKEN RING

IBM Token Ring 16/4 ISA	329.12
IBM Token Ring 16/4 MCA	489.58
IBM Token Ring MAU	459.66

intel

EtherExpress PRO Flash 10BT	115.07
EtherExpress PRO Flash 10BT 5pk	482.72
EtherExpress PRO Flash 10BT 20pk	1489.89
EtherExpress PRO Flash combo	115.07
EtherExpress PRO Flash combo 5pk	505.98
EtherExpress PRO Flash combo 20pk	1827.22
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EtherExpress 16 coax 5pk	464.13
EtherExpress 16 coax 20pk	1608.38
EtherExpress MCA coax	166.52
EtherExpress 16 10BT	99.33
EtherExpress 16 10BT 5pk	464.13
EtherExpress 16 10BT 20pk	1608.38
EtherExpress MCA 10BT	166.52
EtherExpress 16 combo	115.07
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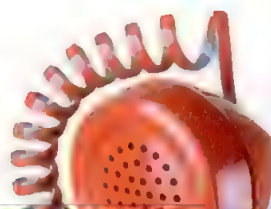
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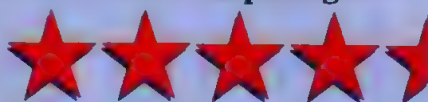
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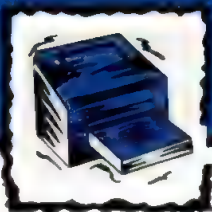
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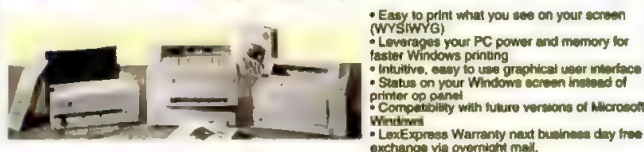
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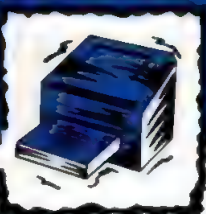
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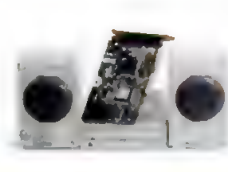
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Texas Instruments

TravelMate 4000M

- ▲ Brilliant color display
- ▲ 16-bit sound card
- ▲ Integrated Pointing device
- ▲ PCMCIA Type III slot

Processor	Screen	Hard Drive	Price
486SX/25	8.2" Enhanced	120MB	\$2039
486SX2/50	9.5" Dual Scan	200MB	\$2759
486SX2/50	8.4" Active	340MB	\$3349
486DX4/75	9.5" Dual Scan	455MB	\$4439
486DX4/75	8.4" Active	340MB	\$4889



TM 4000M

TravelMate Intelligent Docking System

- ▲ 6 16-bit ISA slots
- ▲ 2 PCMCIA Type III slots
- ▲ 2 3.5" and 2 5.25" drive bays
- ▲ Auto Load/Eject feature

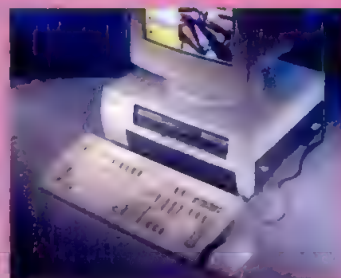
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CD-ROM Docking System

Transform your TravelMate 4000M into the Ultimate Mobile Multimedia System with the Portable CD-ROM docking system

- ▲ Double-speed CD-ROM drive
- ▲ 250ms access time
- ▲ Built-in speakers
- ▲ SCSI II connector

\$81999



TravelMate 4000E Color

Processor	Screen	Price
486SX 25	8.2" Enhanced Color	\$1699
486DX2/40	8.2" Enhanced Color	\$2069
486DX2/50	9.4" Dual Scan	\$2319
486DX2/50	8.4" Active Matrix	\$2819
486DX4/75	8.4" Active Matrix	\$3549
486DX4/75	9.5" Active Matrix	\$4319



TM 4000E

TEXAS INSTRUMENTS

Hewlett Packard Power

LaserJet 4L

- ▲ 4PPM
- ▲ Crisp, 300dpi print-quality
- ▲ 1-year warranty

LaserJet 4L \$609.99*

*Price Includes \$50 rebate through 12/31/94

DeskJet/DeskWriter 540

- ▲ Sharp, 600 x 300 dpi "laser-like" print quality with RET
- ▲ 15% faster color printing with 512kb RAM
- ▲ 3-Year warranty

DeskJet 540 \$289.99

DeskWriter 540 \$289.99

DeskJet/DeskWriter 560C

- ▲ Color 600 x 300 dpi "laser-like" print quality
- ▲ Resolution Enhancement Technology for smooth, crisp text and graphics
- ▲ 3-Year warranty

DeskJet 560C \$479.99

DeskWriter 560C \$479.99



LaserJet 4L

DeskJet/DeskWriter 320

- ▲ High quality 3 PPM printing
- ▲ 600x300dpi with RET
- ▲ 1-Year warranty

DeskJet 320 \$299.99

DeskWriter 320 \$299.99



DeskJet 320

HEWLETT PACKARD

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LaserJet 4P

- ▲ Sharp, 600dpi print-quality
- ▲ 2MB RAM w/Memory Enhancement Technology
- ▲ 1-year warranty

LaserJet 4P \$959.99

LaserJet 4MP

- ▲ True 600dpi resolution
- ▲ Auto switching between Mac and PC environments
- ▲ 1-year warranty

LaserJet 4MP \$1379.99

DeskJet 1200C/PS

- ▲ 45 scalable fonts w/Adobe Postscript Level 2
- ▲ 4MB memory expandable to 20MB
- ▲ 1-year warranty

DeskJet 1200C/PS \$1969.99

DeskJet 1200C

- ▲ Sharp, 600x300dpi "laser-like" print-quality with ColorSmart
- ▲ 2MB memory expandable to 26MB
- ▲ 180 sheet paper tray
- ▲ 1-year warranty

DeskJet 1200C \$1349.99

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PC Computing Five Star Award	YES	
Lifetime Toll-Free Technical Support	YES	
FREE Hardware Configuration	YES	
FREE Software Installation	YES	
Same Day Shipment	YES	
Pre-Installed Software Discount	YES	
All Major Credit Cards Accepted	YES	
Never a Hidden Surcharge	YES	
\$4.95 Shipping on Most Peripherals	YES	
Compaq Authorized for Direct Marketing	YES	
90 Days Same As Cash	YES	
Hewlett Packard and IBM Authorized	YES	
Low Cost Business Leases	YES	
Volume Purchase Agreements	YES	
Customer Satisfaction Is Top Priority	YES	



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AST Value

Ascentia 900N
10.4" Active Matrix screen
now available!

Ascentia 800N

- ▲ 486SX/33 or DX2/50 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 9.5" Dual scan color display
- ▲ PCMCIA Type III slot

Model	Hard Drive	Price
4/33s Model 253W	250MB	\$2299
4/33s Model 343W	340MB	\$2499
4/50d Model 253W	250MB	\$2599
4/50d Model 343W	340MB	\$2739

Lease for \$84/mo.

Bravo LC Desktops

New Generation!

- ▲ 4.8MB RAM exp. to 64MB
- ▲ VESA local bus graphics
- ▲ 1MB video RAM
- ▲ MS-DOS 6.2, Windows 3.1
- ▲ Energy Star Compliant

Model	RAM	Hard Drive	Price
4/33s Model 273W	8MB	270MB	\$1369
4/50s Model 173W	4MB	170MB	\$1199
4/50s Model 273W	8MB	270MB	\$1439
4/66d Model 273W	8MB	270MB	\$1699
4/66d Model 543W	8MB	540MB	\$1829

AST Color Monitors Start at \$369.99

Lease for \$50/mo.

Ascentia 900N

- ▲ 486DX2/50 or 486DX4/75 processor
- ▲ 4MB/8MB RAM exp. to 32MB
- ▲ Large Dual Scan or Active color display
- ▲ PCMCIA type III slot

Model	Screen	Hard Drive	Price
4/50 Model 343W	10.3" Dual scan	340MB	\$3329
4/50 Model 343W	9.5" Active	340MB	\$4869
4/75 Model 343W	10.3" Dual scan	340MB	\$3969
4/75 Model 513W	10.4" Active	510MB	\$5799

Lease for \$83/mo.

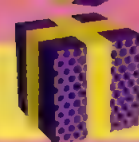


Ascentia 900N



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NEC: Versatility



Ready Multimedia Desktops

- ▲ 486 processor
- ▲ VESA local bus graphics
- ▲ NEC CD-ROM drive
- ▲ SoundBlaster 16 sound card
- ▲ Speakers, microphone
- ▲ 24/96 fax modem
- ▲ MS-DOS, Windows, Quicken
- ▲ CD titles: Compton's Encyclopedia, PFS Window Works

Processor	Hard Drive	Price*
486SX/33 desktop	270MB	\$1349
486DX2/66 desktop	340MB	\$1539
486DX2/66 minitower	420MB	\$1639

*NEC monitors start at \$339.99
Lease for \$50/mo



NEC
Ready Multimedia

MultiSync Monitors

3V

- ▲ 15" SVGA
- ▲ 1024x768, .28mm NI
- ▲ 72MHz VESA refresh
- ▲ MPR II, EnergyStar

2V-14" SVGA-\$314.99*

* Price includes \$25 rebate through 12/31/94

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MultiSpin 4X

600KB/sec transfer rate, 220ms access time. Available stand-alone or with a 16-bit interface card and Microsoft Encarta. **As low as \$389.99**

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500KB/sec transfer rate, 240ms access time. Portable and streamlined for the notebook user. Available stand-alone or with a 16-bit interface card and Microsoft Encarta. **As low as \$389.99**

MultiSpin 2Vi

300KB/sec transfer rate, 320ms access time, IDE interface included, Simple Start, Installation Kit and Microsoft Encarta included. **As low as \$179.99**

2V Deluxe version includes Creative Labs SoundBlaster 16 soundcard, Speakers, batteries and the best selling titles MYST and SimCity. **Just \$299.99**

Compaq Compleat



LTE Elite

- ▲ 486 processor
- ▲ 4/8MB RAM. Exp. to 20/24MB
- ▲ Built-in AC adapter
- ▲ Removable hard drive
- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Integrated trackball
- ▲ MS-DOS 6.0, Windows 3.1, MS Video for Windows Runtime

Processor	Display	Hard Drive	Price
486DX2/40	9.5" Dual scan	170MB	\$3119
486DX2/40	8.4" Active	170MB	\$3779
486DX2/40	8.4" Active	340MB	\$4159
486DX2/50	9.5" Mono	250MB	\$3299
486DX2/50	9.5" Active	340MB	\$4999
486DX4/75	9.5" Active	340MB	\$5669
486DX4/75	9.5" Active	510MB	\$6139

Lease for \$114/mo.

as low as
\$3119



LTE Elite

Contura Aero

- ▲ Type II PCMCIA slot
- ▲ Integrated trackball
- ▲ Weighs only 3.5 lbs. (mono), 4.31 lbs. (color)
- ▲ MS-DOS, Windows 3.1

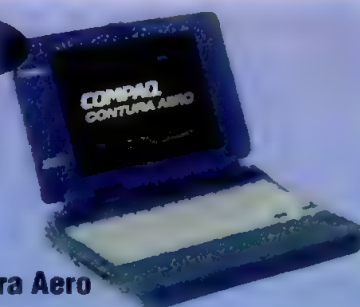
Processor	Display	Hard Drive	Price
486SX/25	8.0" Mono	170MB	\$1139
486SX/33	7.8" Passive Color	170MB	\$1699
486SX/33	7.8" Passive Color	250MB	\$1889

Lease for \$50/mo.



Contura Aero

as low as
\$1139



ProLinea Desktops

- ▲ 4MB RAM expandable to 100MB
- ▲ 3.5" floppy drive
- ▲ Local bus graphics
- ▲ Pentium upgradable
- ▲ Energy Star compliant
- ▲ MS DOS 6.0, Windows 3.1

Processor	RAM	Hard Drive	Price
486SX/33	4MB	200MB	\$999
486SX/2/50	4MB	200MB	\$1119
486DX2/66	4MB	340MB	\$1429
486DX2/66	4MB	525MB	\$1639
486DX4/100	8MB	340MB	\$1939
486DX4/100	8MB	525MB	\$2139

*Compaq color monitors start at \$279.99

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Portégé T3400

- ▲ Ultra-portability at only 4.1lbs
- ▲ 4MB RAM, expandable to 20MB
- ▲ PCMCIA Type II slot
- ▲ External 3.5" disk drive
- ▲ Integrated AccuPoint pointing device

Model	Processor	Screen	Hard Drive	Price
T3400CT	486SX33	7.8" Active	250MB	\$2899
T3600CT	486DX2/50	8.4" Active	250MB	\$4069

Lease for \$106/mo.

T2400

- ▲ 486DX2/50 processor
- ▲ 2 PCMCIA slots (Type II, Type III)
- ▲ Integrated AccuPoint pointing device
- ▲ Optional sound card
- ▲ MS-DOS, Windows for Workgroups

Screen	Hard Drive	Price
9.5" Dual Scan	250MB	\$2929
9.5" Dual Scan	320MB	\$3089
8.4" Active Color	250MB	\$3639
8.4" Active Color	320MB	\$3799

Lease for \$107/mo.



**HOT
PRODUCT**

T4700 and T4800

- ▲ 8MB RAM, expandable to 24MB
- ▲ Brilliant 9.5" color display with local bus video
- ▲ 2 PCMCIA slots (Type II, Type III)
- ▲ Microsoft Sound System, built-in microphone, audio out port
- ▲ MS-DOS, UltraFont, Indeo video compression software, Windows for Workgroups 3.11

Model	Processor	Screen	Hard Drive	Price
T4700	486DX2/50	9.5" Active	200MB	\$4549
T4700	486DX2/50	9.5" Active	320MB	\$4899
T4800	486DX4/75	9.5" Active	500MB	\$5599

Lease for \$166/mo.



T4700

Satellite Notebooks

- ▲ 4MB RAM, expandable to 20MB
- ▲ 9.5" display
- ▲ Type III PCMCIA slot
- ▲ 82-key keyboard
- ▲ MS-DOS, Windows 3.1
- ▲ Ballpoint mouse with Quickport
- ▲ Enhanced power management

Model	Processor	Screen	Hard Drive	Price
T1910	486SX/33	9.5" Mono	200MB	\$1499
T1910	486SX/33	9.5" Dual scan	200MB	\$2039
T1960	486DX2/50	9.5" Dual scan	200MB	\$2379
T1960	486DX2/50	9.5" Dual scan	320MB	\$2629
T1960	486DX2/50	8.4" Active color	200MB	\$3029
T1960	486DX2/50	8.4" Active color	320MB	\$3259

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\$1499



T1910

TOSHIBA



XJACK 14.4/14.4 MODEM

\$219.99

Modem	Description	Price
XJ1144	14.4/14.4 XJACK	\$219.99
CC3144	14.4/14.4 PCMCIA	\$219.99
XJ2144	14.4/14.4 XJACK GOLD	\$249.99
CC4144	14.4/14.4 PCMCIA GOLD	\$249.99

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Stylus Color 240CPS 720dpi with special paper \$599.99
Stylus 800 180cps 360dpi 100 Sheets \$269.99
ActionLaser 1500 6PPM 300dpi \$619.99
ActionLaser 1600 6PPM 600dpi \$999.99

Magnavox

14" SVGA, 1024x768ni, 28mm \$279.99
15" SVGA, 1024x768ni, 28mm \$329.99
15" SVGA, 1280x1024ni, 28mm \$379.99
17" SVGA, 1024x768ni, .31mm \$689.99
20" SVGA, 1280x1024ni, .31mm \$1089.99

**Motorola
CELlect 14.4
PCMCIA or desktop
cellular modems**

\$319.99

PCMCIA



Artisoft

LANtastic V6 0- Starter Kit \$229.99
LANtastic V6 0- 1 User \$79.99
LANtastic V6 0- 5 User \$329.99
NodeRunner SI 2000C \$79.99
Eagle NE200T PCMCIA Ethernet \$199.99
Ask about the complete line of Eagle adapters.

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fax modem
with Voice Mail!**

\$149.99



Maxtor

270MB IDE Drive Enhanced Kit \$189.99
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546MB IDE Drive Enhanced Kit \$299.99
131MB PCMCIA Drive Type III \$339.99
171MB PCMCIA Drive Type III \$389.99

MobileMax 131

\$339.99

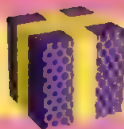


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ThinkPad® 510 subnotebook

- ▲ IBM 486BL2/50 processor
- ▲ 4MB RAM exp. to 20MB
- ▲ 200MB hard drive
- ▲ 7.7" color display
- ▲ Type II PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive
- ▲ Weighs only 3.8 lbs
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0

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as low as
\$1939



ThinkPad®
360

ThinkPad 360® notebooks *HOT PRODUCT*

- ▲ 486SL/33 processor
- ▲ 4MB RAM exp. to 20MB
- ▲ Modular design, removable hard drive & floppy drive
- ▲ Local Bus Graphics with 1MB video RAM
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0

▲ Port Replicator and Docking Station available

Screen	Hard Drive	Price
9.5" Monochrome	170MB	\$1939
9.5" Monochrome	340MB	\$2419
9.5" Dual Scan	170MB	\$2519
9.5" Dual Scan	340MB	\$2999
8.4" Active Color	170MB	\$3389
8.4" Active Color	340MB	\$3869

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- ▲ 486DX/33, DX2/66, or DX4/100 processor, Pentium upgradable
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Z-STAR EX Notebook

High-end features at a low-end price!

- ▲ Cyrix 486DX2/50 processor
- ▲ 4 or 8MB RAM expandable to 20MB
- ▲ Modular design with removable hard drive & floppy drive
- ▲ 32-bit VESA local bus graphics, 512KB video RAM
- ▲ Two Type II or one Type III PCMCIA slot
- ▲ Modem/audio module available
- ▲ Enhanced J-Mouse pointing device
- ▲ Built-in AC adapter
- ▲ MS DOS, Windows 3.1 and CoSession Host software
- ▲ 1 Year Z-CARE on-site service

Processor	RAM	Screen	Hard Drive	Price
486DX2/50	4MB	9.5" mono	200MB	\$1699
486DX2/50	4MB	9.5" dual scan	200MB	\$2179
486DX2/50	8MB	9.5" dual scan	340MB	\$2549
486DX2/50	4MB	9.5" active	340MB	\$3309

as low as
\$1699



Z-NOTEFLEX Multimedia Notebook

Modular architecture for a multitude of user-upgradable features.

- ▲ User upgradable processor, memory, hard drive, display and more
- ▲ 4 or 8MB RAM expandable to 24MB
- ▲ 32-bit VL local bus video
- ▲ Detachable video display
- ▲ Built-in 16-bit stereo sound with speaker and microphone
- ▲ Integrated trackball
- ▲ Two Type II or one Type III PCMCIA slot
- ▲ MS-DOS, Windows for Workgroups, Microsoft Sound System
- ▲ 3-Year Warranty

Processor	RAM	Screen	Hard Drive	Price
486DX2/50	4MB	10.3" dual scan	200MB	\$2869
486DX2/50	4MB	10.3" dual scan	340MB	\$3149
486DX2/50	4MB	9.5" active	340MB	\$4339
486DX2/50	8MB	9.5" active	450MB	\$4759
486DX4/75	8MB	9.5" active	520MB	\$5339

as low as
\$2869

Photo contains
optional equipment



Z-PLAYER Multimedia Unit

A complete portable multimedia solution for any PCMCIA notebook!

- ▲ Integrated double-speed CD-ROM drive, 16-bit stereo sound, speakers & audio in/out ports
- ▲ PCMCIA Type II interface included
- ▲ Upgrade any notebook with PCMCIA to a full multimedia machine in one easy step



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FLEXDOCK port replicator	\$219.99
FLEXBAY floppy bay/battery recharger	\$159.99
FLEXSHOW Multimedia Companion	\$799.99
FLEXSITE LCD Display Stand	\$199.99

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Versa S

- ▲ 486 processor
- ▲ 9.5" screen
- ▲ SurePoint integrated pointing device
- ▲ 2 Type II PCMCIA slots
- ▲ Only 4lbs.

Processor	Screen	Hard Drive	Price
486SX/33	9.5" Mono	210MB	\$1699
486SX/33	9.5" Dual Scan	210MB	\$1889
486SX/33	9.5" Active	210MB	\$2839
486DX2/50	9.5" Active	260MB	\$3299

Lease for \$62/mo.

Versa V

- ▲ 486DX2/50
- ▲ 4MB expandable to 20MB
- ▲ 2 Type II PCMCIA slots
- ▲ MS-DOS 6.2, Windows 3.1, built-in trackball
- ▲ Removable hard drive
- ▲ Removable floppy - add second battery

Screen	Hard Drive	Price
9.5" Dual scan	250MB	\$2839
9.5" Active	250MB	\$3619
9.5" Active	340MB	\$3799
9.5" Active	540MB	\$4279

Lease for \$104/mo.

Versa M

- ▲ 486DX4/75 or 486DX4/100 processor
- ▲ 2 Type II or 1 Type III PCMCIA slots
- ▲ Removable hard drive
- ▲ Removable screen
- ▲ Integrated speaker, microphone
- ▲ MS-DOS, Windows 3.1, Windows Sound System, Video for Windows Run-Time

Processor	Hard Drive	Screen	Price
486DX4/75	340MB	Dual Scan Color	\$3899
486DX4/75	540MB	Active Matrix Color	\$5199
486DX4/100	810MB	Active Matrix Color	\$6049
486DX4/75	540MB	High Res. Active	\$5579
486DX4/100	810MB	High Res. Active	\$6429
486DX4/75	340MB	True Color Active	\$5099

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2. Complement with any or all of these peripherals
3. Stuff your stocking with a \$50 instant rebate on each peripherals*



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MobileMax 131

The MobileMax 131 is the largest capacity PCMCIA Type III hard drive available today! It's able to withstand up to 600Gs of non-operating shock so you can transport large volumes of data between mobile and desktop systems easily and safely.



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NEC
Multimedia 216

NEW! Here's the fastest portable CD-ROM drive on the market! Features 500KB/sec transfer rate, 240ms access time & 256KB continuous flow cache.

\$339.99 after \$50 rebate



Also available with NEC's 16-bit SCSI-2 interface card & Microsoft Encarta for **\$409.99**

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PORTABLE
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Add 16-bit stereo sound to any notebook with this portable sound solution that plugs right into the parallel port. Just awarded the Reader's Choice Award by Multimedia World Magazine for the best portable sound quality!

Includes a built-in speaker microphone and a printer pass-through port.



\$99.99 after \$50 rebate

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PCMCIA
SCSI
Adapter

Take a ride on the fast side with the new NEC PCMCIA SCSI adapter! Now you can make all the right connections for all of your SCSI peripherals including hard drives, scanners, and tape drives.

11 Million business phone numbers on CD-ROM available with NEC PCMCIA SCSI Adapter



\$249.99 after \$50 rebate

Angia's new PCMCIA 28.8/14.4 Data/Fax Modem brings you new speed records in data communications! This V.34 modem allows you to transmit data at throughputs up to 115,200 bps. It's a fax too with speeds of up to 14,400 bps! And at \$50 off it's a super deal!



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Canon Laser LP-4	1MB	N/A	\$109	2MB	N/A	
5159						
Epson Action Laser 1000, 1500	5172	5120ME3	\$35	2MB	2000ME3	\$99
Epson Action Laser 1400	4000	N/A	\$179	16MB	N/A	\$649
HP LaserJet 4	1MB	C2064A				\$49
HP LaserJet 100, 110, 100P, 110D	2MB	334758	\$99	4MB	334770	\$179
HP LaserJet II	2MB	334448	\$110	4MB	334450	\$195
HP LaserJet IIIx, 4, 4M, 4S, 4500X, XL300, DeskJet 1200c	1MB	C2063A	\$39	2MB	C2064A	\$89
4000	C2065A	\$179		8MB	C2066A	\$354
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HP DeskJet 500, 500C, 520, 520C, 550C, 560, 560C	2544	27207B				\$40
HP DesignJet 650C Inkjet Printer	16MB	02227A				\$659
IBM/Lenovo Laser 4029 All Models	2MB	118333A	\$89	4MB	118333S	\$149
IBM/Lenovo Laser 4029, 4079 All Models	4MB	132833	\$149	8MB	132836S	\$329
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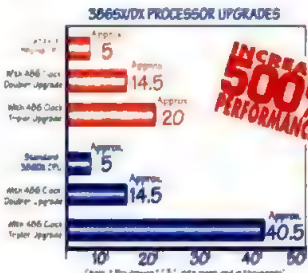
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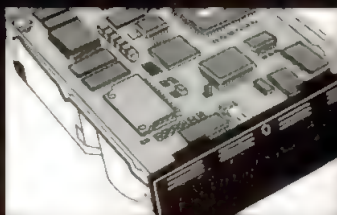
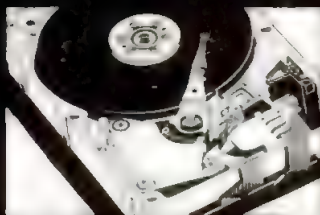
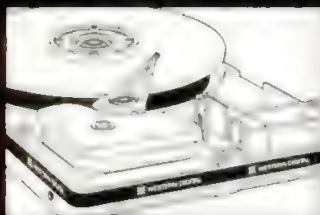
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420MB	14ms	CFS420A	\$205
850MB	10ms	CNR850A	\$419
1275MB	9ms	CNR1275A	\$539

Maxtor

IDE			
170MB	15ms	7171A	\$150
540MB	12ms	7546A	\$265

MICROPOLIS

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1740MB	10ms	MC2217A	\$889
SCSI			
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1740MB	10ms	MC2217	\$889
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3000MB	11ms	MC1936AV	\$1699
4294MB	8ms	MC3243AV	\$2359
9100MB	12ms	MC1991AV	\$3499

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420MB	14ms	ST3491A	\$205
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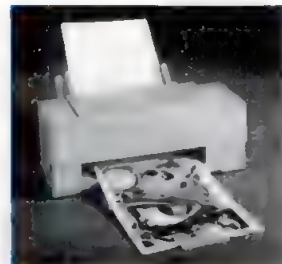
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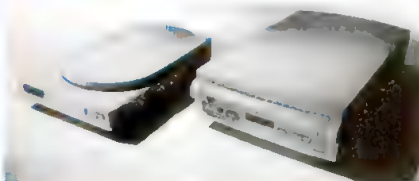


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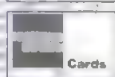
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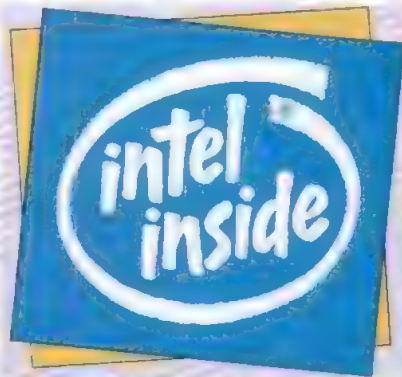
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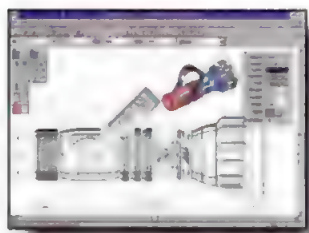
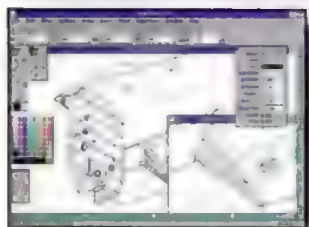


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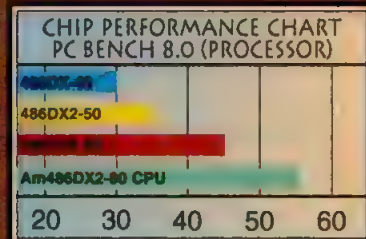
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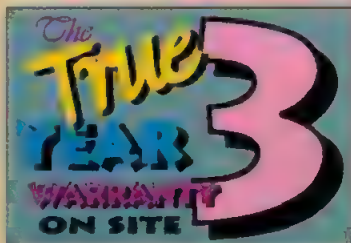
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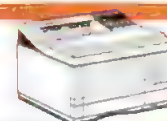
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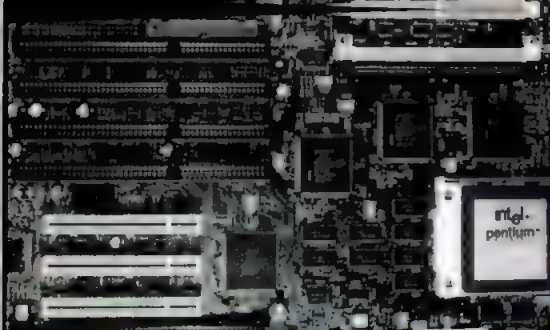
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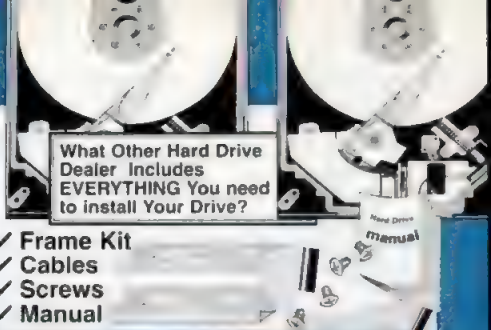
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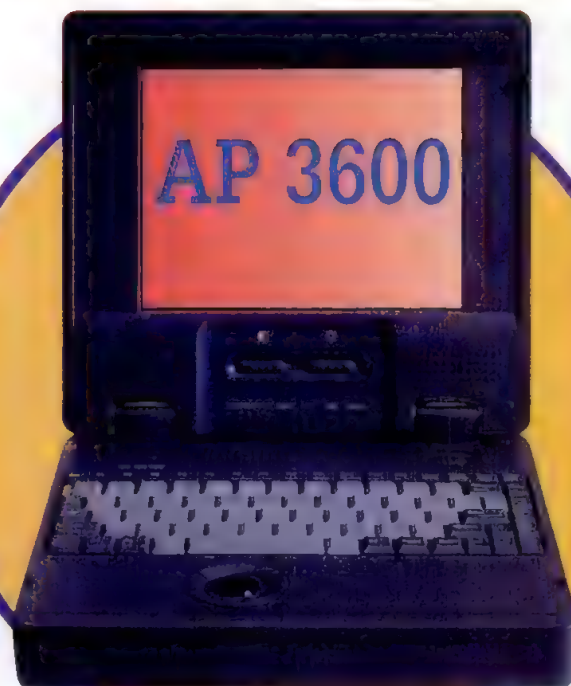
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"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell — and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a \$10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it — closing rate, calls per ad dollar — PC Magazine is tops."

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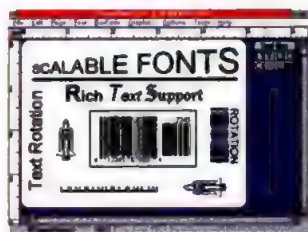
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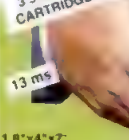
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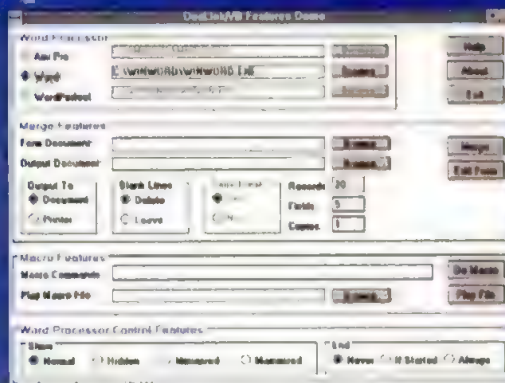
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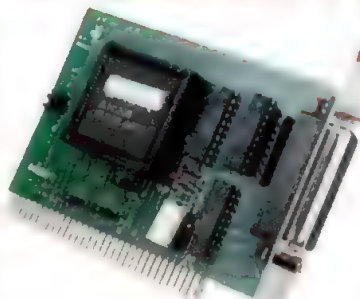


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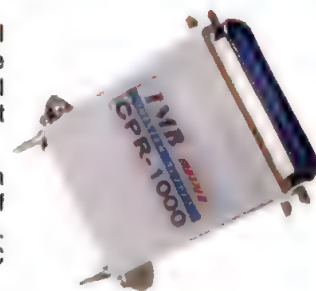
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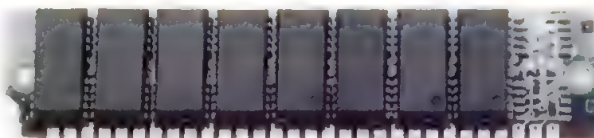
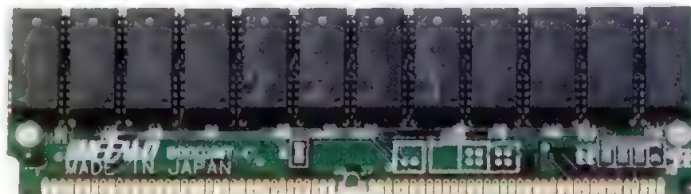
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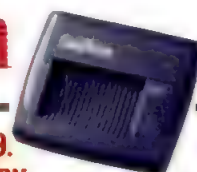


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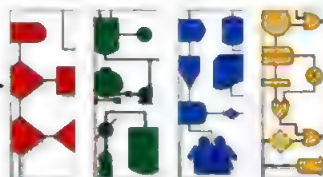
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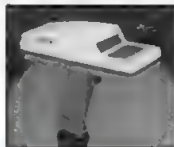


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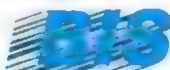
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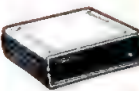
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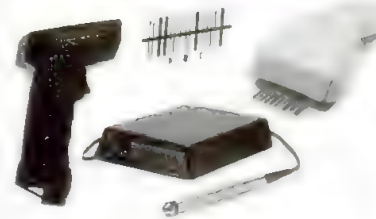
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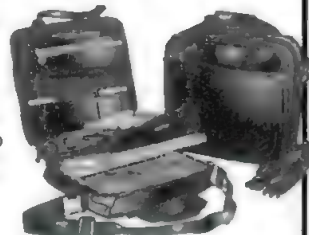
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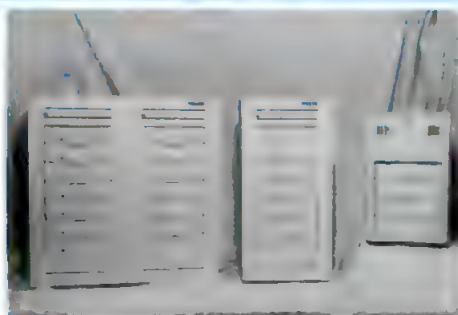
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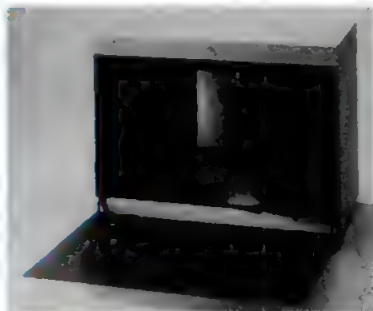
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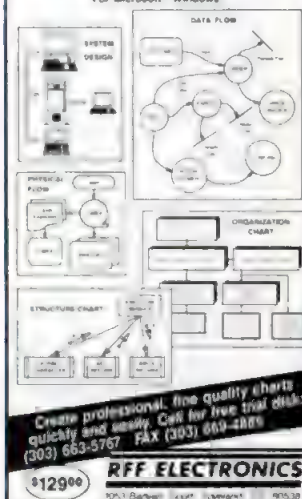
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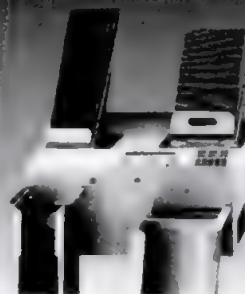
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- 12. ☐ Research and Development
- 13. ☐ Data Processing/Computer Service
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- 09. ☐ Operations
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- 11. ☐ Education/Training
- 12. ☐ Marketing/Sales
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- 14. ☐ Admin./Mgmt.

4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

- 01. ☐ 10 or less 03. ☐ 26-99
- 02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

- 01. ☐ Linked to mainframe
- 02. ☐ Linked to mini
- 03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)

- 01. ☐ IBM or Compatible PCs
- 02. ☐ IBM or Compatible Mainframes
- 03. ☐ IBM or Compatible Minis
- 04. ☐ Macintosh
- 05. ☐ CD-ROM
- 06. ☐ Windows

8. Do you plan to buy any PC products?

- 01. ☐ Now 03. ☐ In 7 to 12 months
- 02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:

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Coming Up

PC Lines: From 486 to Pentium

Thinking of buying a new PC? Has the variety of processor options and the deluge of new systems on the market left you scratching your head? Then look no further: Using our newly updated set of DOS and Windows benchmark tests, PC Magazine Labs measures the performance of 165 systems from more than 50 vendors. We cover everything from entry-level 486DX2 systems to blazingly fast Pentium/90 machines to help you decide how much power you need, what to look for when you buy, and which systems are the best of the bunch.

Graphics Accelerators

The demands on your PC's graphics subsystem grow exponentially all the time, and graphics accelerators become more technically advanced with each passing generation. With speed and affordability in mind, we examine 54 PCI- and VLB-based graphics accelerators available for less than \$400. We put these cards through their paces on the new versions of our WinBench, Winstone, and PC Bench tests, and explore the ramifications of using DRAM-based cards versus using VRAM-based cards, and of having a PCI accelerator as opposed to a VLB accelerator. We also provide a Price/Performance Index so that you can compare a card's price against not only its speed but also its construction, drivers, and extra utilities. Sidebars on new memory technologies and DCI round out our survey of what's available now and what's coming down the road.

New Benchmark Tests

Our next Lab Notes introduces Winstone 95, Version 1.0; WinBench 95, Version 1.0; and PC Bench, Version 9.0. Winstone 95 provides an overall measure of a PC's Windows performance. WinBench 95 paints a detailed portrait of a machine's graphics and disk performance under Windows. And PC Bench 9.0 helps you gauge a system's overall DOS performance. Together, these tools give *PC Magazine* an even greater ability to analyze PC performance.

After Hours Holiday Gift Guide

Can't think of what to buy Dad for the holidays? Forget about another tie, a bottle of cologne, or a set of wrenches. Think software and gadgets for his PC. The After Hours Holiday Gift Guide presents a bevy of gift ideas for everyone on your shopping list, from the littlest preschooler to your oldest maiden aunt. We look at over 60 products—in categories ranging from Kids' Software to Gadgets to Action Games and Home Productivity.

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EDITOR'S RATINGS: ★ Poor ★★ Fair ★★★ Good ★★★★ Excellent

CD DOS

Windows

CD-ROM

Resource-Intensive

Adult Content

Kids (Ages)

Price

Hey, Coach! The Pros Talk Sports

When you want to talk sports, who better to turn to than the experts? Whether you're a couch potato who wants to learn the rules of the game or relive the magic of the play-offs, a scratch golfer who needs a few tips on your tee shot, or a shortstop with a hitch in your swing, the place to turn to is your PC.

The first three packages in this review bring you instruction and information on tennis, golf, and baseball from the people who know sports best: the pros who've played the games. The fourth package brings you commentary on a range of sports from the sports fan's best friend, *Sports Illustrated*.

ESPN Let's Play Tennis With Tracy Austin

★★★★ WIN CD \$49.95

ESPN Lower Your Score With Tom Kite: Shot Making

★★ WIN CD \$79.95

Intellimedia Sports Inc.,
800-269-2101, 404-262-0000.
Circle 509 on reader service card

Pack up your laptop and head for the court or the greens. Intellimedia Sports' ESPN line of sports-instructional software uses virtual coaches and video lessons to help you brush up on your strokes.

ESPN Let's Play Tennis With Tracy Austin is jam-packed with coaching information and playing tips that, though they may not get you to Wimbledon, should get you up to speed for a social game of tennis.

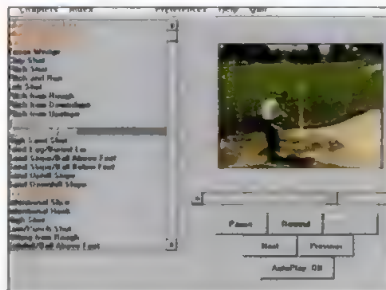
Virtual coach Tracy Austin is joined by tennis experts Cliff Drysdale and Fred Stolle; together, the threesome guide

you through the visual instruction. There are six instruction sections to choose from, and each section is subdivided further, representing a broad treatment of the topic. Learn about grip styles, examine how to serve and return successfully, or select a technique tutorial demonstrating how to play on the baseline, at the net, or in midcourt. All of these skills are demonstrated in video segments.

There are a few shortcomings that beg for better technology. The static background



Perfect your ground strokes with Tracy Austin in ESPN Let's Play Tennis.



Learn to hit out of a sand trap with the Shot Making section of Lower Your Score.

images are jagged and distract from the focal point of the action, which is wholly concentrated in the too-small, TV-shaped box. Depending on your system, the video may at times resemble a poorly dubbed foreign film.

If you find yourself trying to find your way out of a sand trap one time too many, or

even if you just want to shave a few strokes off your golf game, take a look at ESPN Lower Your Score With Tom Kite: Shot Making. As with Let's Play Tennis, this disk relies on video lessons and famous athletes for its appeal.

This dual-CD-ROM package has two components: Shot Making, which offers a veritable stroke-by-stroke breakdown of the game, and Ask the Pros, which gives an in-depth Q&A on a diverse range of topics with PGA great Tom Kite and sports-psychology consultant Dr. Bob Rotella.

Kite also serves as your instructor on Shot Making, guiding you through 33 subjects that cover virtually every shot imaginable. Designed to improve your technique, Shot Making lets you click on a subject to hear audio segments and view a short, somewhat fuzzy video clip of Kite demonstrating the shot. You'll learn everything from stroke-saving shots to shot tips for playing on the green and on the fairway.

The Ask the Pros disk has no video; instead, static images of Kite and Rotella are displayed while audio segments impart tips on playing the game. The selections range from Kite discussing his personal experiences to Rotella explaining the subtleties of emotional control while out on the course.

—Melissa J. Perenson

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Legends and Superstars

It may seem as if baseball as we know it has ceased to exist, but you can recall its glory days every day on your PC, thanks to **Legends and Superstars**.

CD-ROM PICK HIT

This baseball collectible on CD-ROM allows you to combine video clips, beautiful full-color pictures of baseball players, and animated team logos to create custom screen savers and wallpaper. Creating a customized program couldn't be easier, thanks to the point-and-click interface of the DesignCenter. The art is

all high-quality, and some of the music videos are truly comical. One look at "Operetta de Droperetta" is sure to brighten your day.

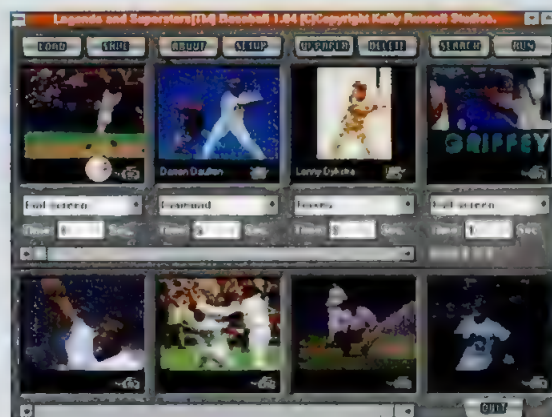
Be warned that installing all of the media clips will devour 10MB of hard disk space. Install just a few, though, and you'll believe that come April there will be baseball again.

—Gayle C. Ehrenman

Kelly Russell Studios, 800-224-4448.

Circle 507 on reader service card

★★★★★  \$49.95



Legends and Superstars gives you all the baseball art you need to create a customized screen saver.

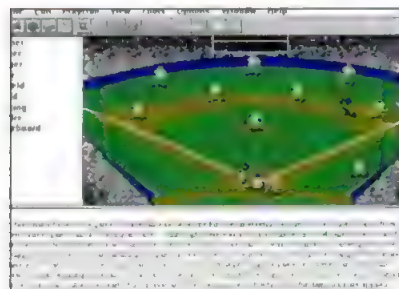
PlayBall!

Great Bear Technology Inc.,
800-795-4325, 510-631-1600.

Circle 503 on reader service card

★★★★★  \$49.95

The cry "Play ball!" is almost as much an American institution as apple



PlayBall! teaches you the history of baseball and the roles of the players.

pie. And PlayBall! is a worthy complement to that institution, serving as a solid resource for information on America's favorite pastime.

PlayBall!'s emphasis is not so much on providing the stats on the hottest teams as it is on explaining how to play the game. This package is suited for all kinds of baseball enthusiasts, from neophytes and casual viewers who want to understand more about the game to Little Leaguers who want to learn how to hit the cutoff man.

The first section examines the baseball diamond. Here you can learn about the roles of the players, get a perspective on what kind of training and preparation is involved in playing a position, and pick up some playing tips from former Chicago White Sox shortstop Alan Banister.

PlayBall! also includes a Playbook, where you can examine standard scenarios and plays, such as bunts, pickoffs, and steals. There's also an address book with relevant baseball-stadium and team-contact information, a trivia game that tests how well you've absorbed all this information, and a legendary-baseball-quotes option that spews dubiously pertinent quotes.

Although PlayBall! will appeal to anyone with an interest in baseball, perhaps it will be most appreciated by those who'd like to understand the game they've seen on television for years.—Melissa J. Perenson

PROBLEM SOLVER

Try practicing in front of a mirror the skills these programs teach you. Since you can't get live feedback, a mirror is the easiest way to make sure your body is in the proper position for hitting that shot.

Sports Illustrated 1994 Multimedia Sports Almanac

StarPress Multimedia Inc.,
415-274-8383.

Circle 504 on reader service card

★★★★★  \$59.95

It's 3:00 A.M. and you just have to know who won the Orange Bowl in 1993. Where to turn? To the pros at *Sports Illustrated*, of course.

This multimedia CD-ROM contains an entire year of *Sports Illustrated* and an expansive almanac with over 1,200 pages of professional and collegiate sports records and statistics, as well as all the multimedia bells and whistles you could hope for.

While this is a *Sports Illustrated* title, the emphasis here is on sports achievements and personalities rather than on bathing beauties. So you'll find the complete text of the renowned Swimsuit Issue here, but not the photos. What you will find is an impressive selec-

tion of video highlights that cover all of 1993's most important sports events, a well-produced Year In Review segment, and all of the articles and many of the color photos from the 54 issues *Sports Illustrated* published in 1993.

Everything on the CD-ROM is easy to locate, thanks to an innovative point-and-click interface that is as attractive as it is intuitive. All of the icons animate when selected; clicking on the baseball icon produces the



Sports Illustrated 1994 Multimedia Almanac is a sports junkie's best friend.

crack of a bat and a baseball sailing across the screen.

The one place this disk falls short is in its coverage of lower-profile sports. For information and observations on the major sports, however, this disk can't be beat. Look for annual updates to keep this series vital for years to come.

—Gayle C. Ehrenman

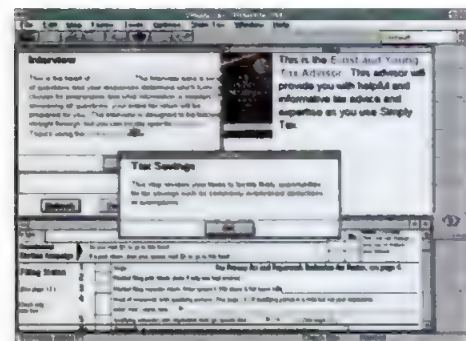
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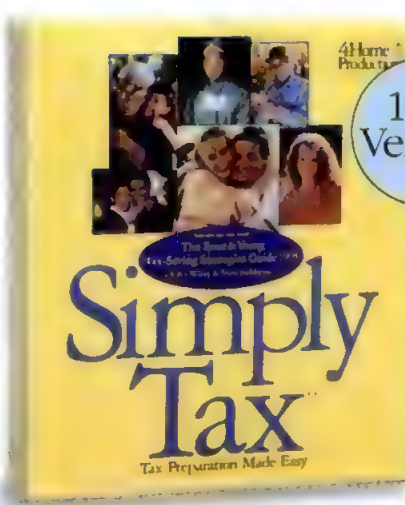
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Strategy

Kick, Coach, and Crunch Your Way to Gridiron Glory

Ultimate NFL Coaches Club Football

MicroProse Software, 800-879-7529, 410-771-0440.

Circle 505 on reader service card

★★★    \$50.00

If you think you can do a better job of calling plays than Joe Montana, now's your chance to put your money where your remote control is. Ultimate NFL Coaches Club Football is as close to the action as you can get without donning shoulder pads.

This simulation lets you control all aspects of the game, from the teams that will play to your own position as a coach or a player, the type of stadium you'll play in, the weather and wind conditions

at game time, and the plays in your playbook. And all this gets determined before the opening kickoff! Once the game begins, you get to huddle up while you decide which play (offensive or defensive) to run, pick the appropriate formation, make substitutions, and then snap the ball. If you're in Action Mode, you also get to control the ball handler. Of course, if that pass play succeeds, you can watch the touchdown on instant replay.



Ultimate NFL Coaches Club Football lets you run your own teams and leagues.

The graphics and sound effects here are fairly impressive, but what sets Ultimate Football apart is its NFL connection, which means that your teams are made up of NFL players from the 1994 rosters. And for fantasy-league participants, there's an option to download weekly

stats via Prodigy/FFL Stat Service (\$79.95 per season) and to organize league play.

Just be sure that you configure your computer's memory in precisely the way that Ultimate Football demands, or you'll never get out of the locker room.

—Gayle C. Ehrenman

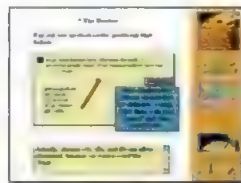
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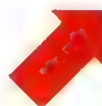
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After Hours

Simulations

War in Miniature

Fields of Glory

Spectrum HoloByte, 800-695-4263.

Circle 506 on reader service card

★★★ CD-ROM \$42.95

There's nothing like beating back Wellington at Waterloo to give your ego a boost. In *Fields of Glory*, you get the opportunity to rewrite such history, fighting historically based battles of Napoleon's Waterloo campaign.

In this incredibly detailed depiction of the French Emperor's return from the isle of Elba to do battle with the Anglo-Allied and Prussian armies, you command animated toy soldiers as they charge,



You can fight on either side of the Napoleonic Wars in the miniature military simulation, *Fields of Glory*.

blast, and hack their way across the Belgian countryside.

You can choose from four historical and two fictional battles and pick which commander you'd like to be. As part of the game's authenticity, you can choose to have the troops deployed according to historical accounts or modify the placement of your troops

prior to battle.

There is no gratuitous gore in *Fields of Glory*. In fact, the closest you get to the action is the 1-mile-wide aerial view of the battlefield, which portrays the soldiers, in abbreviated numbers, doing battle in a robotic, time-lapse manner. You can also use the 4- and 8-mile views to get the bigger picture.

Infantry, Cavalry, and Artillery are portrayed in miniature, different flag types distinguishing various commanders on the field. While your troops can do battle automatically, you can also control their actions manually. Though some of the deployment commands seem to go unheeded by overzealous brigades that refuse to stop where you command them to, the game does an excellent job of maintaining several different lines of movement at once. When you see your troops advancing near the enemy, you can zoom in to the 1-mile view to see them duke it out with your foe.

The manual includes exceptionally detailed descriptions of each weapon, commander, and army, with lengthy accounts of the historical battles. All of this information is also available in an on-line database.—*Stephen W. Plain*

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The Scrapbook feature stores hundreds of photos per person. Enter captions and descriptions for easy searching and sorting. Print photos in family trees or in album pages. There's even an on-screen slide show. Advanced features also allow users to import graphic files (BMPs, TIFs, etc.) and embed and play OLE objects, such as home video clips.

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The FamilyFinder™ makes it easier and faster to find your ancestors. With the FamilyFinder feature, you'll speed up your family search by weeks without ever leaving your desk! The FamilyFinder is an amazing list of 100 million deceased people whose names appear in state and federal genealogical records. While it doesn't contain the records themselves, it does tell you **exactly** where to find information about each person.

The Genealogy "How-To" Guide gives you even more help in finding your ancestors. This on-line guide tells you how to begin, and who to contact. Plus, it lists the addresses of all state and county record offices. There's even help for doing research abroad.

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Kids

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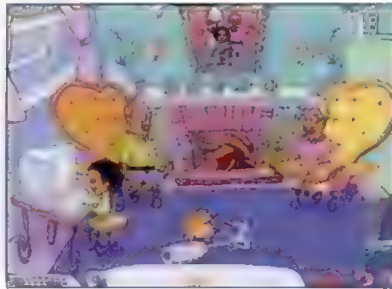
★★★★  \$49.95

Sometimes young children need help minding their p's and q's, and a little advice from a trustworthy friend goes a long way. In Mavis Beacon Teaches Typing! For Kids, children learn keyboard layout and develop typing skills from typing expert Mavis Beacon's younger persona, Little Mavis.

Mavis For Kids is not a boiled-down version of the

successful Mavis Beacon adult series; this program is written specifically for young children. The package provides adept examples, lively animations, and spoken help that keep children interested as they learn proper keyboarding.

As the program opens, Little Mavis invites young typists to visit her grandparents' home in the country, where they get to choose among six activity areas and help Little Mavis and her dog Dizzy complete tasks



Now kids can learn to type with popular instructor Mavis Beacon.

such as feeding the fish in the pond. Keystrokes are rewarded with on-screen animations

QUICK CLIPS

Recommended
If You Call
Not Recommended

Archibald's Guide to the Mysteries of Ancient Egypt

Kids can while away some time along the Nile with Osiris and his crew. Just don't let them try out the mummification techniques this CD-ROM explains. \$39.95; Swfie International, 302-234-1740.

Mad Dog McGree II: The Lost Gold

Shoot fast pardner, or you'll never get to see all the fuzzy videos on this CD-ROM. Better yet, just head to an arcade. \$59.95; IBM Multimedia Publishing Studio, 800-898-8842.

Upfront Sex, Drugs and Rock & Roll

More limp than lurid game show that proposes to teach teens about the dangers of drugs and unprotected sex. Sometimes seems more like a guidebook than a warning. \$48; Cambridge Labs Inc., 800-808-7627.

ZipZapMap! USA

Knowing where South Dakota is located won't help you as much as having a fast hand at the keyboard. Fun as a puzzle, but a flop as a geography lesson. \$29.95; National Geographic Software, 800-368-2728.

and speech. In the Pond activity, for example, when you type a letter, a word beginning with that letter is spoken and a food bubble containing that letter is

launched to feed the fish. As children become proficient at the activities, the program's skill level increases—and so does the fun.—Charles Taft

SPOTLIGHT ON ACTION

TIE Fighter

LucasArts has given *Star Wars* fans a good reason to, in the words of Darth Vader, "give in to the Dark Side." Not only does the Empire strike back in LucasArts' space-fighter simulation TIE Fighter, it hits solid gold.

Instead of flying with the goody-two-shoes Rebel pilots as you did in X-Wing, here you fly against them. In TIE Fighter, our antihero has joined the Secret Order of the Emperor, and the Imperial Navy is hot on the heels of the Rebel Alliance as they flee the ice-planet Hoth.

But TIE Fighter is not merely a replay of X-Wing with a different cockpit layout; many game elements have been dramatically improved. There are more and better-looking ships than ever, including the pesky Rebellion fighters, new freighters, warships, and a Corellian

multipurpose transport that looks like the one piloted by that rogue Han Solo. The various animations and plot-advancing cut scenes, as well as the sound effects, are skillfully executed.

The missions have been revamped too, so you can learn more now about your mission objectives. These objectives are flexible, so you have primary goals necessary for successful completion of the mission as well as secondary goals that will earn you extra points. Complete your missions and you'll graduate from the quick but vulnerable



TIE Fighter places you in the cockpit of an Empire plane as you battle the Rebel forces.

TIE fighter to more advanced craft. Easy, medium, and hard difficulty levels allow you to find a comfortable playing field.

It's a bit harder to empathize with the evil Imperial forces than with Luke Skywalker. Despite this, TIE Fighter is an addictive, engag-

ing, even spectacular game and a must-buy for space-combat fans. TIE Fighter ends far too soon; fortunately, extra mission disks are on the way.

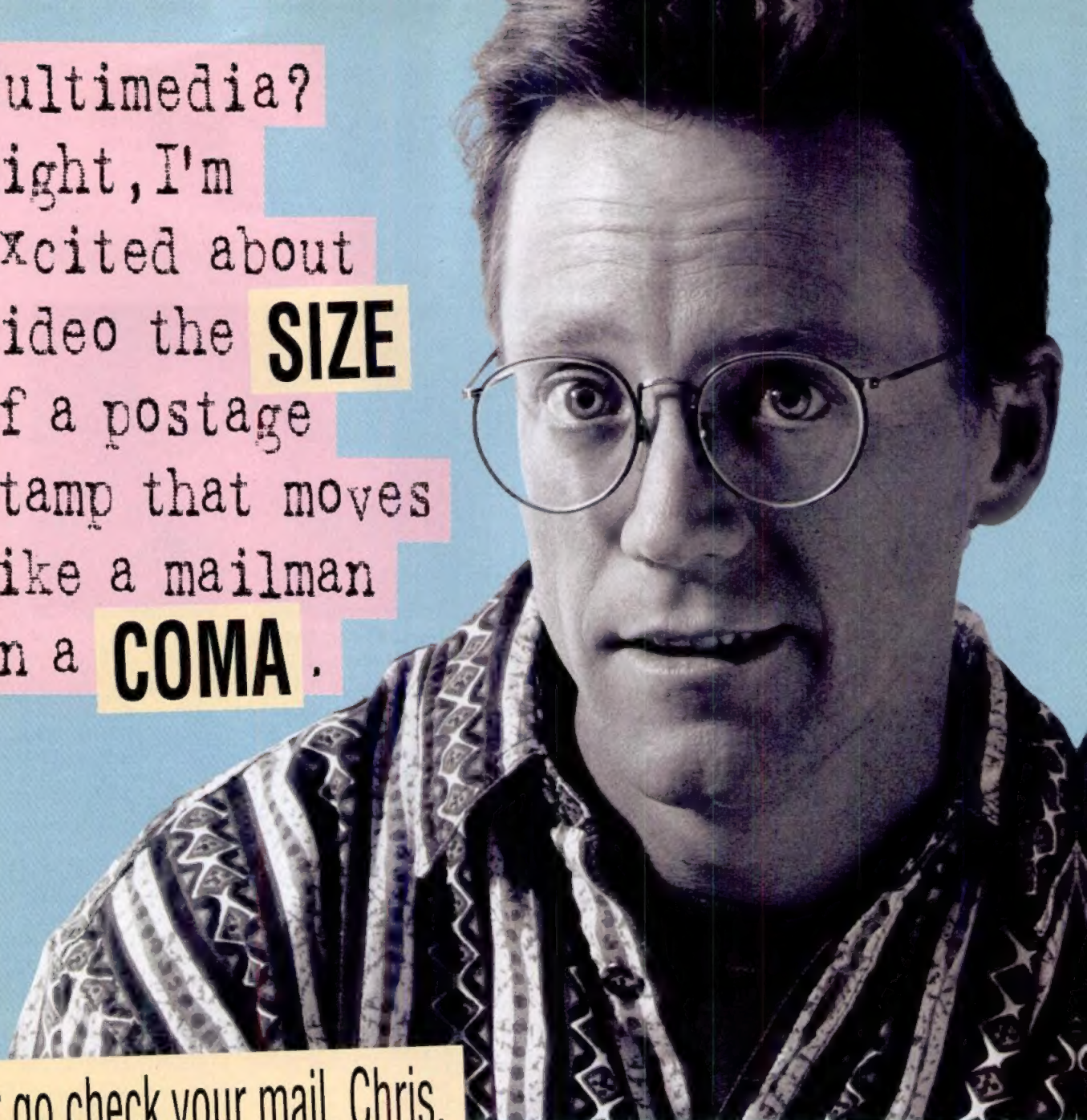
—Bernard H. Yee

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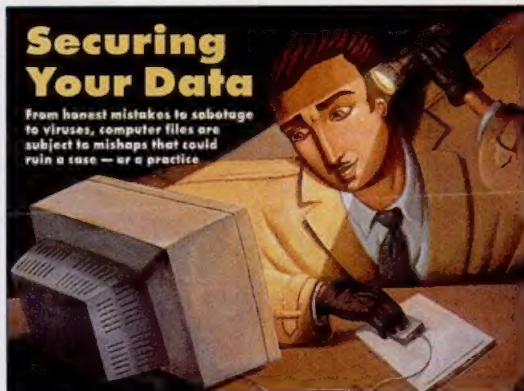
By Don Willmott

Score One for the Dunce Cap Revival Movement

Faithful reader Ernie Delgado, who owns a Futurekids Computer Learning Center, reports that during a class called "Introduction to PCs and DOS," a woman remarked, "I'm really glad I signed up for this DOS class, but when are you offering the DON'TS class?"

Securing Your Data

From honest mistakes to sabotage to viruses, computer files are subject to mishaps that could ruin a case — or a practice.



Then Mix In the Eggs And Flour

"If you install a RAM cartridge, change configuration switch B2 to the up position

Hope this spy brought along a glare filter, too. (ABA Journal.)

Hey, Dude, Don't Bogart The NetWare

"Major employers in the [Provo] area include R.R. Donnelley (publishing, advertising), WordPerfect Corporation (computer programming)...[and] Novell (drugs)."

—HOME INCORPORATED

10 YEARS AGO IN PC MAGAZINE

"Sperry Computer Systems has introduced the Sperry Portable Computer... The 38-pound computer has 256K RAM and is expandable to 512K RAM... It uses an Intel 8088 processor running at 4.77MHz... The Model SPX has a single floppy disk drive and a 10MB hard disk and sells for \$4,985."

to use the RAM as additional input butter." —HP DESKJET 520 MANUAL

ARF on the Road: Austin, Texas. (Your hard disk will never fail again.)



5 1/4" Disk Drive Head Cleaner

Why Marketing Execs Remain Single

"Spectrum HoloByte... says 40 percent of [Tetris] buyers are women, whereas buyers of most of its other games are 99 percent male. Marketing executives are trying to find out why the sexes are different."

—THE ANCHORAGE DAILY NEWS



Grrrrrunch! Flip that floppy disk around or you'll do more than just clean the head. (ACI ad.)

If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802. Winners this issue: T. Joseph Crumley, Ernie Delgado, Gene Griffin, James Handermann, Kirby Krieger, Michael Pearson, and Kenneth Pickel.

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